Repair Instructions for Babytherm 8000

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1. Mechanical system

1.1 Trolley

The Babytherm 8000 is available with various trolleys:

- Units with no electrical height adjustment:
  - o Small base plate for heated cot
  - o Large base plate for intensive-care model or reanimation unit. This version permits installation of a radiant heater.
- Units with electrical height adjustment
  - o Small trolley for heated cot
  - o Large trolley for intensive-care module or reanimation unit. This version permits installation of a radiant heater.

1.1.1 Trolley for units without height adjustment

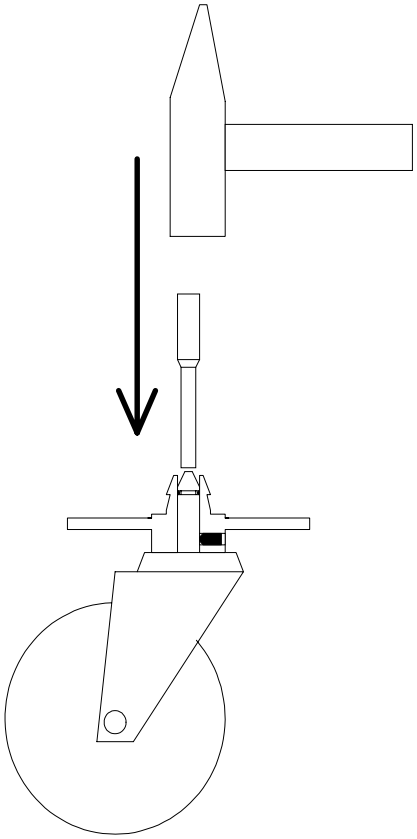
The trolley consists of a trolley plate small or large which is keyed to the metal casing of the column.

This trolley has the following castors:

2 x	castor	2M 21 048
2 x	locking castor	2M 21 050

The metal ends and the castor attachment points are secured in each case with caps 2M 20 989.

1.1.1.1 Removal and installation of castors



- Pull off cap 2M 20 989 upwards.
- Jack up trolley at castor to be removed.
- Attention: Units manufactured in 1995 (ARJx-xxxx) may be equipped with castors which are additional secured by a hexagon socket-head screw M6. In this case, remove screw.
- Knock out castor with hammer (approx. 0.2 - 0.5 kg) and pin punch
- Install in reverse order. Make sure that circlip is fitted on pin of castor (part of scope of delivery of castors).
- In the case the castor was secured by a hexagon socket-head screw, this screw must be affixed using Loctite 221 (order no. 79 01 966).
- Fit cap

1.1.2 Trolley for units with height adjustment

There are two possibilities:

-	Large trolley	2M 21 036
-	Short trolley	2M 21 038

These trolleys have the following height adjustments:

-	Height adjustment 230V	2M 20 940
-	Height adjustment 230V (extra high) (must nor be used on the Heated Cot with the short trolley 2M 21 038)	2M 21 174
-	Height adjustment 115V	2M 20 946
-	Height adjustment 110V (extra high)	2M 21 175

(must nor be used on the Heated Cot with the short trolley 2M 21 038)

In each case with the control unit:

o Foot pedals, complete 2M 20 290

These trolleys have the following castors:

- 2 x castor 2M 20 792
- 2 x locking castor 2M 20 794
- The castors are held in position in each case by the caps 2M 20 348.

1.1.2.1 Removing and installing castors

The castor pins are held in position in the tubular section by the orange caps 2M 20 348, see Fig. from drawing 2M 21 036. The castors can be pressed out of the tubular section using two screwdrivers.

Important: Do not apply leverage to plastic parts of castors.

Should this not prove possible, cut off orange cap 2M 20 348 at end of tubular section and press out castor pin from inside.

1.1.3 Replacement in repair situation

Replacement parts are available in line with the spare parts list.

1.2 Column with electrical height adjustment

These trolleys feature the following height adjustments:

- Height adjustment 230V 2M 20 940
- Height adjustment 230V (extra high) (must nor be used on the Heated Cot with the short trolley 2M 21 038) 2M 21 174
- Height adjustment 115V 2M 20 946

- Height adjustment 110V (extra high) (must nor be used on the Heated Cot with the short trolley 2M 21 038) — 2M 21 175

  In each case with the control unit:

  - o Foot pedals, complete — 2M 20 290

1.2.1 Height-adjustment technical data

Height adjustment 230V:

- Dynamic force: 750 N
- Stroke: 295 mm
- Speed: 12 - 15 mm/s
- Voltage: 220 - 240 V / 50/60 Hz
- Current consumption: 2.5A
- Leakage current: < 0.1 mA
- Fuses:
  - o Temperature switch (self-resetting)
  - o 2 x fuse DIN 41662 T3.15A — 18 15 148

Height adjustment 115V:

- Dynamic force: 750 N
- Stroke: 295 mm
- Speed: 12 - 15 mm/s
- Voltage: 100 - 127 V / 50/60 Hz
- Current consumption: 5 A
- Leakage current: < 0.1 mA
- Fuses:

- o Temperature switch (self-resetting)
- o 2 x fuses DIN 41662 T6.3A 18 15 172

1.2.2 Foot pedals, complete 2M 20 290

The height adjustment is controlled by the foot pedal assembly 2M 20 290.

- Foot pedals, complete 2M 20 290
- Connection diagram 2M 20 370
- Wiring harness 2M 20 213

1.2.3 Replacement in repair situation

Replacement parts are available in line with the spare parts list.

1.3 Base plate for resting surface and accessory rails

The resting surface is attached to the base plate. The Babytherm 8000 comes with various base plates:

- Small base plate and small trolley for heated cot
  - o Base plate, small (with handles 2M 20 860) 2M 21 148
- Large base plate and large trolley for intensive-care module or reanimation unit. This version permits installation of a radiant heater.
  - o Base plate, large (with handles 2M 20 862) 2M 21 146

Caution: Large base plate is never to be installed on small trolley!

1.3.1 Replacement in repair situation

Replacement parts are available in line with the spare list.

1.4 Socket strip

Caution: The 3x earthing-contact socket strip beneath the base plate of the resting surface is only intended for:

- **Babytherm mattress heating**

- **Dräger radiant heater RH 600 (not in the USA and Canada)**

- **Babytherm height adjustment**

Other loads are not permitted!

Important: The radiant heater envisaged at the factory is provided with an inlet connector for non-heating appliances. The appropriate connecting cable is pulled through the rail on the back.

Important: Retrofitted loads are not to be connected to the socket strip as otherwise the data on the rating plate will no longer be correct!

Electrical safety is tested by way of the common power cord.

1.4.1 Replacement in repair situation

Replacement parts are available in line with the spare parts list.

1.4.2 Repair information and modification statuses

1.4.2.1 Alteration of class type B to BF (12.94)

The future Standard for mattress heating IEC 601-2-35 (as at 12.94) prescribes that the resting surface is no longer to be earthed and that class type BF (Body Floating) must be used. The units are currently being supplied as type B (Body) i.e. with earthed resting surface. Production of the Babytherm 8000 with mattress heating is to be switched as of the start of 1995 to class type Typ BF; prior to this date roughly 300 units will be delivered with the old class type B.

Subsequent alteration from type B to BF is not envisaged.

Power cord for mattress heating control:
This refers to the short internal mains lead 2M 21 220 between the triple socket in the Babytherm and the mattress heating control.

Type B	Type BF
Ferrite 18 34 967 required on cable	No longer ferrite on cable. If already fitted, ferrite need not be removed

Important: A summary of class alteration from type B to BF is given in Section 9.3. Consult this Section in the event of doubt.

1.5 Resting surface

1.5.1 General information

The resting-surface assembly consists of the following:

- Resting surface
- Bottom-section tilt mechanism, bolted to base plate
- Mechanical system of tilt mechanism
- 4 corners for holding glass panels

Various side panels can be attached to the resting surface:

- Tall side panels for heated cot or
- Deep side panels for reanimation unit

The resting surface comes with (heated cot) and without (reanimation unit) mattress heating:

With mattress heating:

- Gel mattress 2M 20 827

  The mattress heating panel is only intended for the gel mattress 2M 20 827!

> Danger:
>
> The gel mattress 2M 20 827 may only be used in the Babytherm 8000 in conjunction with the resting-surface heater!
>
> The gel mattress 2M 20 827 is not to be used in the Babytherm 4200 and in other heated cots with a heating-panel temperature in excess of 40 °C ⇒ danger of burns!
>
> Keep sharp objects away from gel mattress ⇒ danger of damage!

Without mattress heating:

- Foam mattress 2M 21 012
- Babytherm 8000 dummy panel 2M 21 067

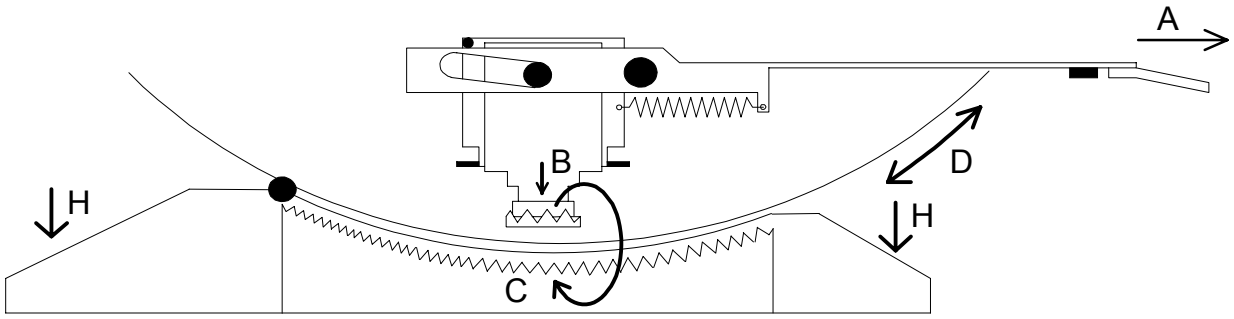
(for electronics opening)

-	4	Dummy plugs 14.3 mm	83 02 977
-	2	Dummy plugs 38 mm	2M 21 341

1.5.2 Testing and adjusting resting-surface tilt mechanism

1.5.2.1 Function

The bottom section of the resting-surface tilt mechanism is connected to the base plate with 4 hexagon socket-head bolts. This section contains the resting surface with support being provided on one side by rollers and on the other side by teflon strips as anti-friction bearings. The resting surface is fixed by way of a gear mechanism in the bottom section and the latch for the mechanical system of the resting-surface tilt mechanism.



Pulling the lever **A** presses the latch **B** downwards out of the gear mechanism **C** and the resting surface **D** can be swivelled out of its basic position by +15° to -20°. The lever is pulled back again in each case by two springs and the resting surface thus fixed in position.

1.5.2.1 Checking function in situ

- Presence of and check on the two return springs 83 00 445

  ⇒ The spring force must be sufficient to reliably return the lever to its initial position

- Pull out lever **A** approximately half way (20 mm):

  ⇒ Resting surface remains fixed in every position

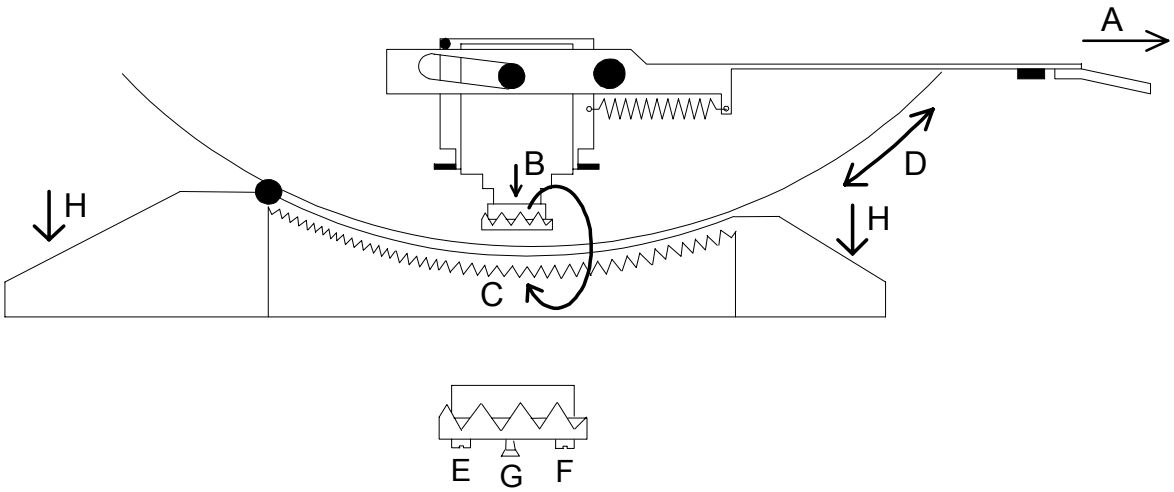
- Pull out lever **A** to 3/4 of overall distance (30 mm):

  ⇒ Resting surface can be silently adjusted

Important: Refer to 1.5.2.2 if resting surface is released too soon or not soon enough or if it does not reliably engage in every position.

1.5.2.2 Testing and adjustment following removal

- Remove complete resting surface. To do so interrupt mains connection to electronics assembly or remove the electronics module and screw out the four hexagon socket-head bolts **H**.



- Visually inspect gear mechanism **C** in resting-surface section; there must not be any signs of wear.

- Visually inspect gear mechanism **B** of latch 2M 20 855 of mechanical system of resting-surface tilt mechanism. To do so un screw out bolts **E** and **F**. There must not be any signs of wear. Reattach latch. Important: The bolts **E** and **F** are secured with epoxy hardening glue (UHU Plus).

- Visually inspect tilt mechanism: All moveable parts must be greased with Molykote 55M order no.15 54 093.

- The 4 teflon sliders must not be greased.

- Presence of and check on the two return springs 83 00 445

  ⇒ Spring force must be sufficient to reliably return lever to initial position.

- Pull out lever **A** approximately half way (20 mm):

⇒ Resting surface remains fixed in every position.

- Pull out lever **A** 3/4 of the total distance (30 mm):

  ⇒ Resting surface can be silently adjusted

- The disengaging/engaging travel of the latch can be adjusted by way of the screw **G** at the latch:

  o Resting surface is released too early:

    Loosen the screw **G** a few turns. Unscrew the bolts **E** and **F** and apply epoxy hardening glue (UHU Plus, order no. 11 95 255) on their threads. Screw in the bolts **E** and **F** and re-tighten them. Repeat the test.

  o Resting surface is not released too late or is not released properly:

    Remove the bolts **E** and **F** and screw-in the screw **G** a few turns. Apply epoxy hardening glue (UHU Plus, order no. 11 95 255) on the threads of the bolts **E** and **F**. Screw in the bolts **E** and **F** and re-tighten them. Repeat the test.

- Reattach resting surface

- Electrical safety check

1.5.3 Corners and side panels

1.5.3.1 Testing

The corners and side panels must be checked for reliable closure. If this is not the case or if there are visible signs of wear, the panel hinges or housing corners are to be renewed.

1.5.3.1 Removing and installing corners

Knock corners upwards with plastic hammer. Installation involves reverse procedure.

1.5.3.2 Side-panel hinges

The hinges of the side panels can be renewed; this requires use of the following spare parts:

- S-set for hinge, left 2M 21 084
- S-set for hinge, right 2M 21 082

A 2 mm bit and a drill are needed for assembly.

1.5.4 Replacement in repair situation

Replacement parts are available in line with the spare parts list.

1.5.5 Testing after replacement

- Check reliable locking of panels
- Visually inspect correct installation of all parts
- Check resting-surface tilt mechanism (see 1.5.2.1)
- If heating or electronics assembly has been removed:
  - o Electrical safety check
  - o Functional check (Test time at least 20 minutes)
    - Heating function

- Mains failure alarm
- Data storage with mains failure alarm
- Function of keys
- Function of display elements
- No error messages

1.5.6 Repair information and modification statuses

1.5.6.1 Mounting the mechanics of the resting-surface tilt-mechanism (9.94)

With immediate effect, the mechanics of the resting-surface tilt-mechanism must be mounted with 4 Spax screws (order no. 12 75 593). Devices already in service must be retrofitted with this type of screws, see IDM no. 1 and conversion instructions under "U", Chapter 2.1. The two cylinder head screws of the latch 2M 20 855 and the screw on the control lever must be secured with epoxy hardening glue (UHU-Plus, order no. 11 95 255).

1.6 Accessories

1.6.1 Cabinet

-	Cabinet mount, complete	2M 20 868
-	Swivel cabinet	2M 20 638

1.6.2 Rail for resting-surface

-	Modification kit rail	2M 21 468

2. Pneumatic system

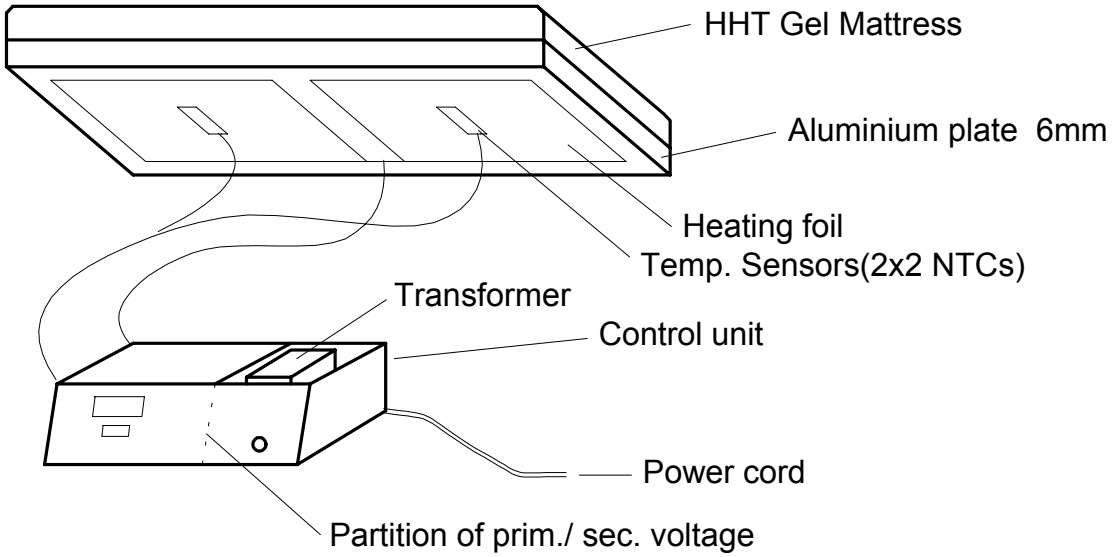
2.1 Extraction

The extraction is not part of this documentation.

3. Heating panel with sensors

3.1 General information

The heating panel consists of an aluminium backing plate (6 mm) to which a heating foil 24V / 120W is bonded and two twin temperature sensors are bolted.



To distinguish between type B and BF the mattress heating control and heating panel have different plugs for the heating connection:

Type B (old)	-	3-pin connector for heating cable, one cable for protective conductor
Type BF (new)	-	2-pin connector for heating cable

As not all parts of the mattress heating are interchangeable, the modified components have new order numbers. Always pay attention to repair information when performing repairs.

The heating panel is only intended for the gel mattress 2M 20 827

Danger:

The gel mattress 2M 20 827 may only be used in the Babytherm 8000 in conjunction with the resting-surface heater!

The gel mattress 2M 20 827 is not to be used in the Babytherm 4200 and in other heated cots with a heating-panel temperature in excess of 40 °C ⇒ danger of burns!

Keep sharp objects away from the gel mattress ⇒ danger of damage!

3.2 Heating-panel assembly

The heating panel consists of the following components:

- Backing plate 2M 20 878
- All-round seal for backing plate 2M 20 882
- Foil heating 24V/120W bonded on for type BF 2M 21 509
- Twin temperature sensor 2M 20 859
  The sensors are fitted with thermal conduction paste at the backing-plate contact surfaces.

The heating panel is secured in position in the cot from underneath with four bolts.

The heating panels for types B and BF have different order numbers.

The following heating-panel parts differ:

Heating panel 2M 20 877 for type B	**Heating panel 2M 21 510 for type BF**
Double temp. sensor 2M 20 859 with shield connected to sensors. Identification: No yellow and blue shrink-down tubing at sensors. Sensor cannot be converted to type BF.	Double temp. sensor 2M 20 859 with insulated shield on sensor end, distinguished by sensors with blue and yellow shrink-down tubing. This sensor can also be used in type B. Alteration has already been made on some units of type B.
Foil heating 2M 20 876 with 3-pin connector: - 2 x heating - Protective conductor	Foil heating 2M 21 509 with 2-pin connector: - 2 x heating

Important: In future only the new heating panel 2M 21 510 will be available. The new heating panel 2M 21 510 for type BF will then have to be converted to type B in the event of repair. This will involve taking over the protective-conductor cable connection and 3-pin heating connector from the defective heating panel 2M 20 877. In this case the protective conductor connection is to be laid separately from the heating cables. To remove the connector, use can be made of the tool "Extractor for crimp socket 2.6 mm" with the order no. 79 01 120; another possibility is to make use of ballpoint-pen refills (with metal tube) with a tube ID of approx. 2.6 mm.

3.2.1 Heating and sensor connections

- Heating for type B:

Pin	Color	Significance
1	not yellow/green	Heating
2	not yellow/green	Heating
3	yellow/green	Protective conductor

- Heating for type BF:

  2 x Heating

- Twin temperature sensor (2 x 2 sensors):

  Refer also to drawing, wiring harness, twin temperature sensor 2M 20 875 under "S".

Pin	Color	Significance	Temperature module assignment on controller PCB
1	blue	Sensor 1, first half	Module 1
2	red	Sensor 1, first half	Module 1
6	black	Sensor 2, first half	Module 2
7	white	Sensor 2, first half	Module 2
4	blue	Sensor 1, second half	Module 3
5	red	Sensor 1, second half	Module 3
9	black	Sensor 2, second half	Module 4
10	white	Sensor 2, second half	Module 4

There is no preferential position for the two halves on the backing plate.

3.3 Testing

Refer to 3.5

If there is any doupt as to the accuracy of the temperature on the resting surface perform the following test at a room temperature of 20 to 30 °C:

- Adjust setpoint to 36.0 °C
- Place the point of the fluid temperature probe of the temperature and humidity set 79 01 148 on the centerof the heating plate such that the point touches the plate.
- Cover the plate with the gel mattress 2M 20 827
- Cover the gel mattress with the foam mattress 2M 21 102
- If possible cocer the resting surface with the hood 2M 21 030
- Allow the unit to warm up at least 2 hours
- Important: Do not use any additional radiant heater!
- Test value of the reference temperature instrument:

  Reading = 36,0 ± 1,0 °C

3.4 Replacement in repair situation

The following spare parts are available for repairs:

For type B:

-	Heating-panel assembly	2M 20 877
o	Twin temperature sensor	2M 20 859
o	Backing-plate seal	2M 20 882

For type BF:

-	Heating-panel assembly	2M 21 510
o	Twin temperature sensor	2M 20 859

- o Backing-plate seal 2M 20 882

The following heating-panel parts differ:

Heating panel 2M 20 877 for type B	Heating panel 2M 21 510 for type BF
Double temp. sensor 2M 20 859 with shield connected to sensors. Identification: No yellow and blue shrink-down tubing at sensors. Sensor cannot be converted to type BF.	Double temp. sensor 2M 20 859 with insulated shield on sensor end, distinguished by sensors with blue and yellow shrink-down tubing. This sensor can also be used in type B. Alteration has already been made on some units of type B.
Foil heating 2M 20 876 with 3-pin connector: - 2 x heating - Protective conductor	Foil heating 2M 21 509 with 2-pin connector: - 2 x heating

Important: In future only the new heating panel 2M 21 510 will be available. The new heating panel 2M 21 510 for type BF will then have to be converted to type B in the event of repair. This will involve taking over the protective-conductor cable connection and 3-pin heating connector from the defective heating panel 2M 20 877. In this case the protective conductor connection is to be laid separately from the heating cables. To remove the connector, use can be made of the tool "Extractor for crimp socket 2.6 mm" with the order no. 79 01 120; another possibility is to make use of ballpoint-pen refills (with metal tube) with a tube ID of approx. 2.6 mm.

3.5 Testing after replacement

Assemble unit ready for operation.

- Visual inspection:
  - o Correct installation of heating panel and seal
  - o Proper connection of heating to electronics assembly
  - o Correct installation of electronics assembly
- Functional check (Test duration at least 30 minutes):
  - o Adjust setpoint to 37.0 °C.
  - o If setpoint higher than actual value:
    - ⇒ Heating LED flashes

- o Adjust setpoint to 38.0 °C.
- o Interrupt mains connection:
  - ⇒ Visual and acoustic mains failure alarm
- o Re-establish mains connection:
  - ⇒ Unit continues to operate with setpoint of 38 °C

- Testing in DS mode, see 6.2 if actual value greater than 37 °C:
  - o Read out all four temperature values in each case in DS mode 6.2.1 - 6.2.4; the permitted deviation between the minimum and maximum temperature value is 0.4 °C. Important: The displayed value in DS mode is 1.0 °C higher than the value normally displayed in operation.
- Electrical safety check

3.6 Repair information and modification statuses

3.6.1 Alteration of class type B to BF (12.94)

The future Standard for mattress heating IEC 601-2-35 (as at 12.94) prescribes that the resting surface is no longer to be earthed and that class type BF (Body Floating) must be used. The units are currently being supplied as type B (Body) i.e. with earthed resting surface. Production of the Babytherm 8000 with mattress heating is to be switched as of the start of 1995 to class type Typ BF; prior to this date roughly 300 units will be delivered with the old class type B.

Subsequent alteration from type B to BF is not envisaged.

The difference can be seen from the stamp next to the rating plate of the Babytherm:

Type B: Type BF:

(Figure with no box)

(Figure in box)

To distinguish between type B and BF the mattress heating control and heating panel have different plugs for the heating connection:

Type B (old) - 3-pin connector for heating cable, one cable for protective conductor

Type BF (new) - 2-pin connector for heating cable

As not all parts of the mattress heating are interchangeable, the modified components have new order numbers. Always pay attention to repair information when performing repairs.

The heating panels for types B and BF have different order numbers.

The following heating-panel parts differ:

Heating panel 2M 20 877 for type B	**Heating panel 2M 21 510 for type BF**
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Foil heating 2M 20 876 with 3-pin connector: - 2 x heating - Protective conductor	Foil heating 2M 21 509 with 2-pin connector: - 2 x heating

Important: In future only the new heating panel 2M 21 510 will be available. The new heating panel 2M 21 510 for type BF will then have to be converted to type B in the event of repair. This will involve taking over the protective-conductor cable connection and 3-pin heating connector from the defective heating panel 2M 20 877. In this case the protective conductor connection is to be laid separately from the heating cables. To remove the connector, use can be made of the tool "Extractor for crimp socket 2.6 mm" with the order no. 79 01 120; another possibility is to make use of ballpoint-pen refills (with metal tube) with a tube ID of approx. 2.6 mm.

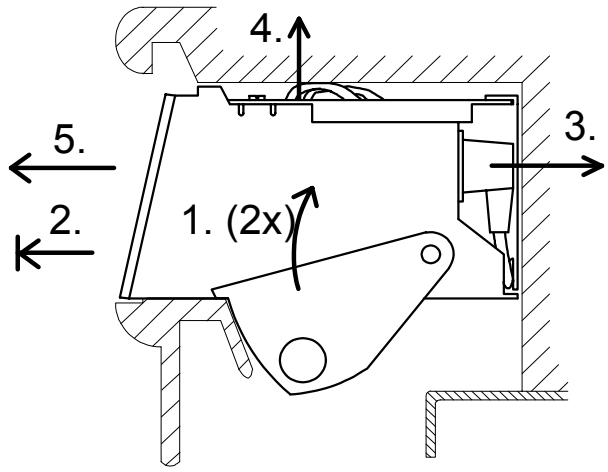
Important: A summary of class alteration from type B to BF is given in Section 9.3. Consult this Section in the event of doubt.

4. Mattress heating electronics

4.1 Removal and installation of electronics and components

4.1.1 Removing and installing electronics assembly

Important: Components can be effected by static electricity!

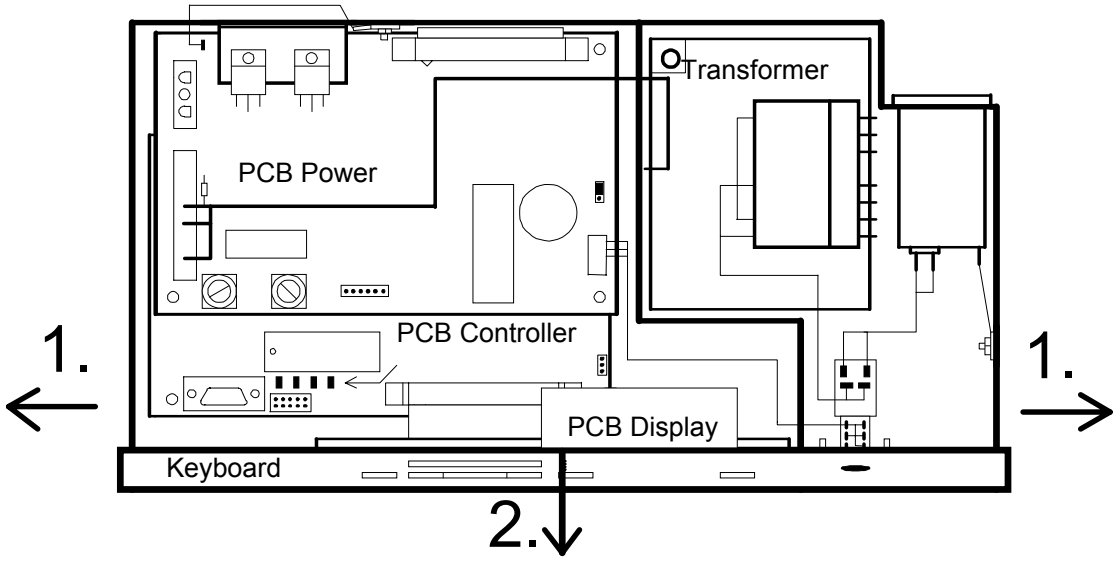


- Interrupt mains connection to Babytherm
- 1. Swing up the two side catches on the electronics assembly
- 2. Pull electronics assembly slightly out of Babytherm
- 3. Detach mains connection
- 4. Detach sensor and heating connecting cable
- 5. Pull out electronics assembly
- Install in reverse order

4.1.2 Opening electronics assembly

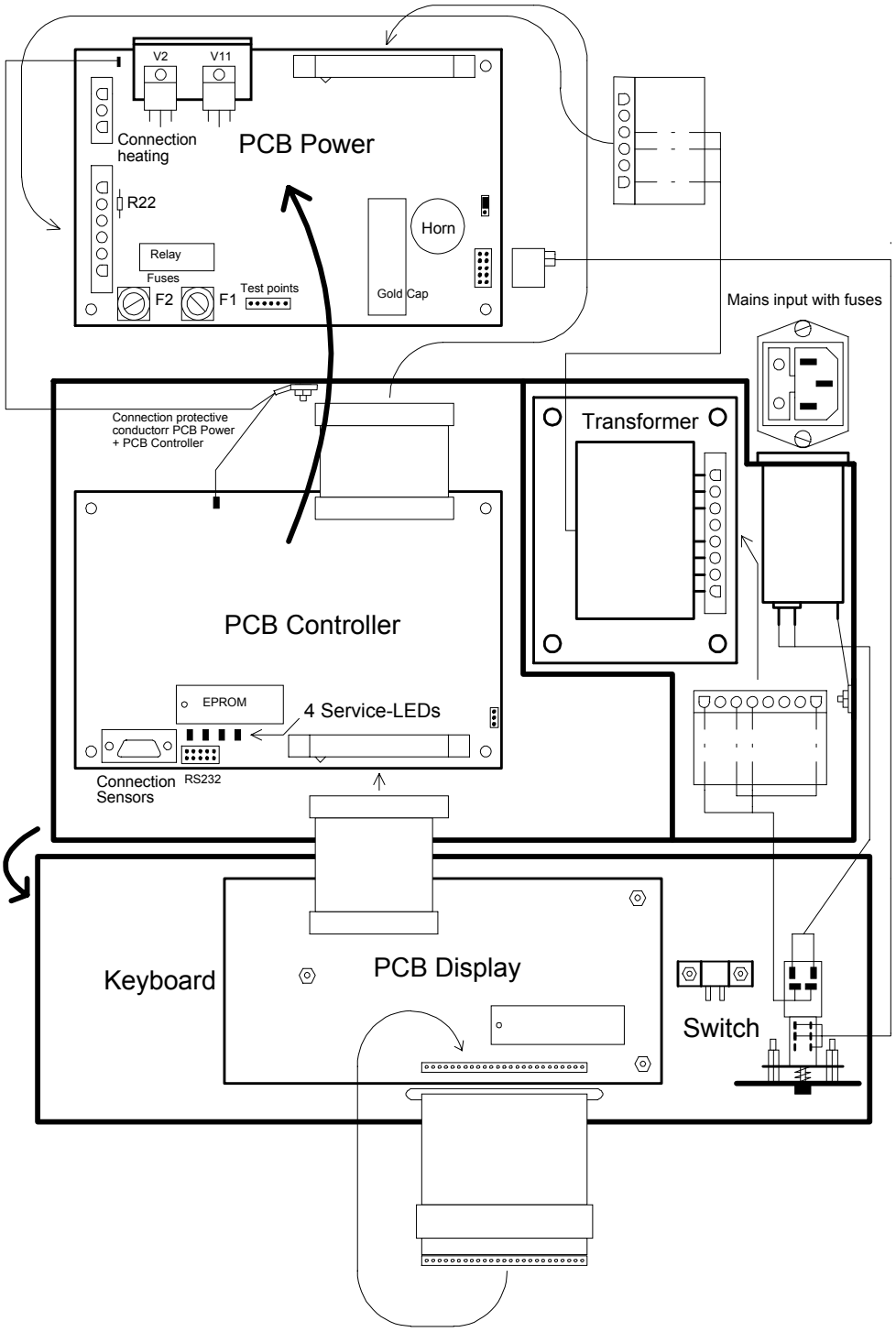
Important: Components can be effected by static electricity!

- Loosen both screws in the cover of the electronics assembly (do not screw out); push cover forwards and remove upwards.
- Detach cable connections from connectors in cover to printed circuit cards.
- Bend housing apart on side (1.) and tilt keypad with display PCB forwards (2.).



- Install in reverse order.

4.1.3 Wiring diagram



Important: 100 - 127 V units feature a voltage adapter from the accessory set: voltage conversion 2M 21 176 between mains switch and transformer.

4.1.4 Display PCB, keypad and mains switch

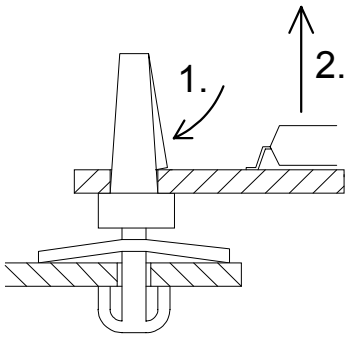
Important: Components can be effected by static electricity!

- Remove electronics assembly (see 4.1.1)
- Open electronics assembly (see 4.1.2)
- Detach cable connections to keypad and display PCB (see 4.1.3 wiring diagram)
- Display PCB is attached to keypad with three nuts
- Mains switch with wiring harness is attached to keypad
- Perform installation in reverse order

4.1.5 Power PCB and controller PCB

Important: Components can be effected by static electricity!

- Remove electronics assembly (see 4.1.1)
- Open electronics assembly (see 4.1.2)
- Detach cable connections to keypad and display PCB, (see 4.1.3 wiring diagram)
- Power PCB is attached with three snap fasteners and a screw connection (at the heat sink) whereas controller PCB is secured in position with four snap fasteners.
    - o Loosen screw connection for power PCB
    - o Squeeze snap fastener **1** together and raise printed circuit card **2**; snap fastener engages again on installation.



    - o Important: There are two replacement snap fasteners at the dividing wall in the electronics assembly.
    - o Removal of the controller PCB may involve removal of the snap fasteners for the power PCB. To do so, squeeze snap fasteners

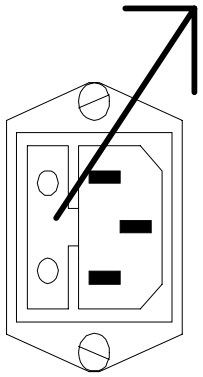
together at bottom with pointed pliers and press out fasteners upwards.

- Install in reverse order

4.1.6 Mains input with mains fuses

4.1.6.1 Mains fuses

- Remove electronics assembly (see 4.1.1)
- Pull out fuse compartment next to mains socket.
- Following fuse ratings must be used:



  - o 220/240V units:

    2 x fuse DIN 41662, T800mA 18 15 075

  - o 100/127V units:

    2 x fuse DIN 41662, T1.6A 18 15 105

- Slide fuse compartment back in again
- Re-install electronics assembly

4.1.6.2 Removing and installing mains input

Important: Components can be effected by static electricity!

- Remove electronics assembly (see 4.1.1)
- Open electronics assembly (see 4.1.2)
- Detach cable connections at mains input (see 4.1.3 wiring diagram)
- Mains input is attached to housing with two screw connections
- Install in reverse order

4.1.7 Transformer, adapter for mains voltage conversion 100 - 127 V

Important: Components can be effected by static electricity!

- Remove electronics assembly (see 4.1.1)
- Open electronics assembly (see 4.1.2)
- Detach cable connections to transformer (see 4.1.3 wiring diagram)
- 100 - 127 V units feature the voltage adapter 83 06 462 from the accessory set for voltage conversion 2M 21 176 between mains switch and mains input of transformer.
- Transformer is attached to housing with four screw connections
- Install in reverse order

4.2 Electronics, complete

4.2.1 General information

The electronics module contains the entire control system for the mattress heating. The module is made up of the following components:

- Controller PCB
- Power PCB
- Display PCB
- Mains switch
- Transformer
- Keypad
- Mains input
- Adapter for voltage conversion (100/127 V units only)

The repair information for these individual components is given in sections 4.3 - 4.9

4.2.2 Voltage conversion

As the heating is driven via the transformer, the mains voltage is no problem to convert.

The following is required for conversion from 220/240V to 100/127V:

- Accessory set, voltage 100/127V 2M 21 176

Important: It is not possible to change the voltage for the optional height adjustment!

4.2.3 Testing electronics, complete

Assemble unit ready for operation, but do not fix electronics assembly in position in housing. Connector for attaching sensor cable to unit is therefore accessible.

Switch on unit:

- All displays and horn are actuated for 1.2 s
- Then:
  - o Setpoint display = 37.0 °C
  - o Measured value and label "SEt" flash up alternately on actual value display. Important: measuring range 5 °C - 45 °C.
  - o Pressing one of the keys " ⇑ " or " ⇓ " setpoint produces constant actual display.
- Without prior pressing of range expansion key setpoint can be adjusted to between 35.0 °C and 37.0 °C.
- After prior pressing of range expansion key setpoint can be adjusted in each case to min 30.0 °C or max. 38.5 °C.
- Adjust setpoint to 37.0 °C.
- Press "check" key:
  - o All displays and horn are actuated for 2 s.
  - o All displays and horn then off for 2 s.
  - o This is followed by return to original display.
- If setpoint higher than actual value:

- o Heating LED flashes

- If actual value is in range between 35.5 °C and 38.0 °C, adjust setpoint in each case to 1.1 °C higher or lower than actual value:

  - o Visual and acoustic alarm ± 1 °C

  - o Acoustic alarm can be suppressed with "horn off" key

- Adjust setpoint to 38.0 °C.

- Interrupt mains connection:

  - o Visual and acoustic mains failure alarm

- Re-establish mains connection:

  - o Unit continues to operate with setpoint of 38 °C

- Disconnect plug from sensor cable at assembly:

  - o Visual and acoustic sensor alarm

- Reconnect plug

- Testing in DS mode, see 6.2, if actual value greater than 37 °C:

  - o Read out all four temperature values in each case in DS mode 6.2.1 - 6.2.4. The permitted deviation between the minimum and maximum temperature value is 0.4 °C. Note: The value displayed in DS mode is 1.0 °C higher than the value normally displayed in operation.

- Instead of sensors, connect up Babytherm 8000 test plug (35 °C + 1 °C Offset) 79 00 965.

- Testing in DS mode, see 6.1:

  - o Read out all four temperature values in each case in DS mode. Test value is always 35.0 ± 0.2 °C.

- Switch off unit and assemble ready for operation.

- Electrical safety check.

4.2.4 Replacement in repair situation

If a defective assembly cannot be repaired by replacing individual components, the following spare parts are available:

For Type B:

- Electronics assembly 220/240V, complete 2M 20 880
  - o Conversion set 100/127V 2M 21 176
- Repair/replacement electronics assembly 220/240V, complete 2M 21 095

For Type BF:

- Electronics assembly 220/240V, complete 2M 21 500
  - o Conversion set 100/127V 2M 21 176
- Repair/replacement electronics assembly 220/240V, complete 2M 21 506

Important: The control system 2M 20 880 and the RAT (repair/replacement) control system 2M 21 095 for type B will no longer be available in future.

Type BF controls are to be ordered as spare part for the old type B. On installation, merely the housing cover with the two wiring harnesses (heating adapter and sensor adapter) is to be taken over from the defective control system. The marking on the housing of the new control system is to be changed to type B and the order no. from 2M 21 500 to 2M 20 880.

4.2.5 Testing after replacement

The following tests are to be performed after replacement of the electronics assembly:

- Visual checks:
  - o Correct mains voltage set in electronics assembly (see 4.2.3).
- Electrical safety check
- Functional test (Test duration at least 20 minutes)
  - o Function of heating

- Mains failure alarm
- Data storage with mains failure alarm
- Function of keys
- Function of display elements
- No error messages

4.2.6 Repair information and modification statuses

4.2.6.1 Alteration of class type B to BF (12.94)

The future Standard for mattress heating IEC 601-2-35 (as at 12.94) prescribes that the resting surface is no longer to be earthed and that class type BF (Body Floating) must be used. The units are currently being supplied as type B (Body) i.e. with earthed resting surface. Production of the Babytherm 8000 with mattress heating is to be switched as of the start of 1995 to class type Typ BF; prior to this date roughly 300 units will be delivered with the old class type B.

Subsequent alteration from type B to BF is not envisaged.

The mattress heating controls 220/240V for types B and BF have different order numbers.

Type B	Type BF
Mattress heating control 2M 20 880 Distinguishing feature: - 3-pin heating connection	Mattress heating control 2M 21 500 Distinguishing features: - 2-pin heating connection - Order no. printed on - Marked "BF"
RAT mattress heating control 2M 21 095	RAT mattress heating control 2M 21 506

Important: The control system 2M 20 880 and the RAT (repair/replacement) control system 2M 21 095 for type B will no longer be available in future.

Type BF controls are to be ordered as spare part for the old type B. On installation, merely the housing cover with the two wiring harnesses (heating adapter and sensor adapter) is to be taken over from the defective control system. The marking on the housing of the new control system is to be changed to type B and the order no. from 2M 21 500 to 2M 20 880.

Wiring diagram/wiring harnesses

There is no change to the cable connections between the PCBs. The only alteration is to the wiring harnesses (sensor adapter and heating adapter), i.e. the two cable connections from the cover to the PCBs.

Type B	Type BF
Wiring harness Heating adapter 2M 21 096 3-pin adapter cable without ferrite between heating connection on	Wiring harness Heating adapter 2M 21 507 2-pin adapter cable with ferrite between heating connection on

housing cover and power PCB.	housing cover (2-pin) and power PCB (3-pin).
Wiring harness Sensor adapter 2M 21 094 Wiring harness with ferrite 18 31 577 between sensor connection on housing cover and controller PCB. This cable can also be used in type BF.	Wiring harness Sensor adapter 2M 21 508 Wiring harness without ferrite between sensor connection on housing cover and controller PCB

Controller PCB

Use in the type BF requires additional capacitors in the measurement input which cannot be retrofitted in the field. Retrofitting has already been performed if the modification number after the order no. is ³ 1.1, i.e. the PCB is marked with 82 90 688 - 1.1 or a higher modification number. Some units of type B already feature this modification.

Controller PCB 82 90 688 ≤ 1.0	**Controller PCB 82 90 688 ≥ 1.1**
Only for use in type B. Use in type BF could result in destruction of measurement input caused by the influence of voltage peaks	Can be used in types B and BF

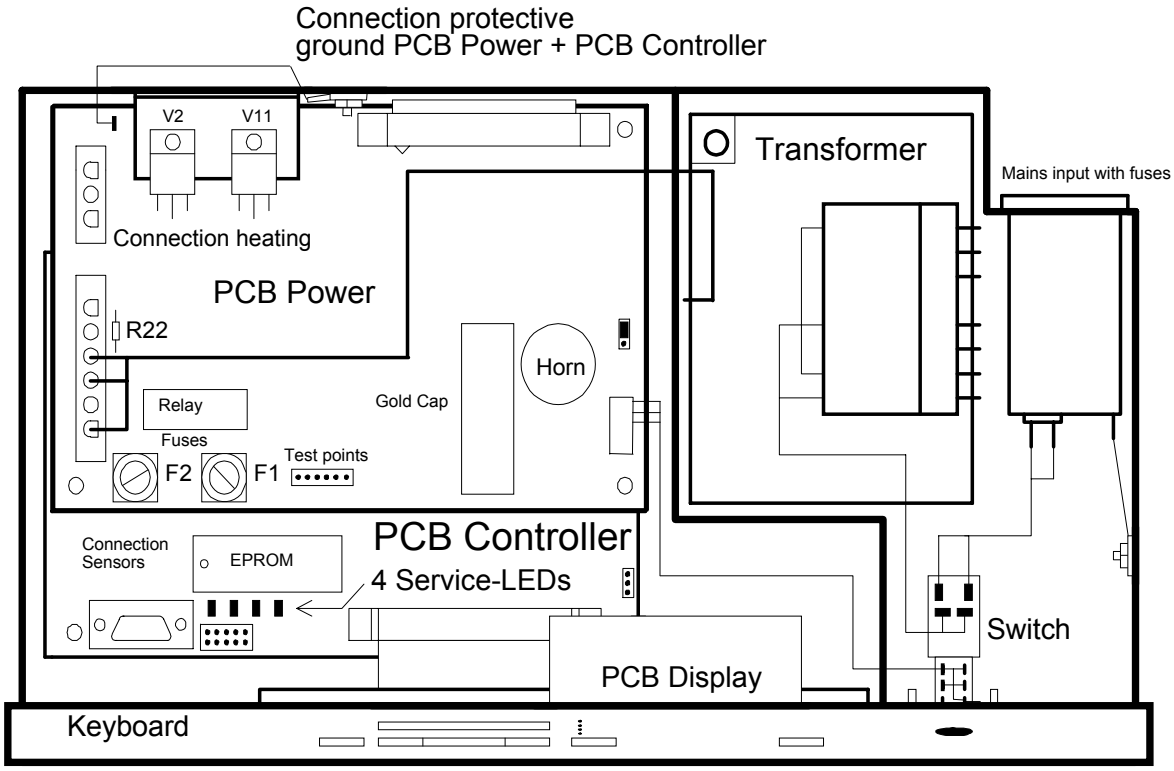
Important: A summary of class alteration from type B to BF is given in Section 9.3. Consult this Section in the event of doubt.

4.3 Controller PCB

4.3.1 General information

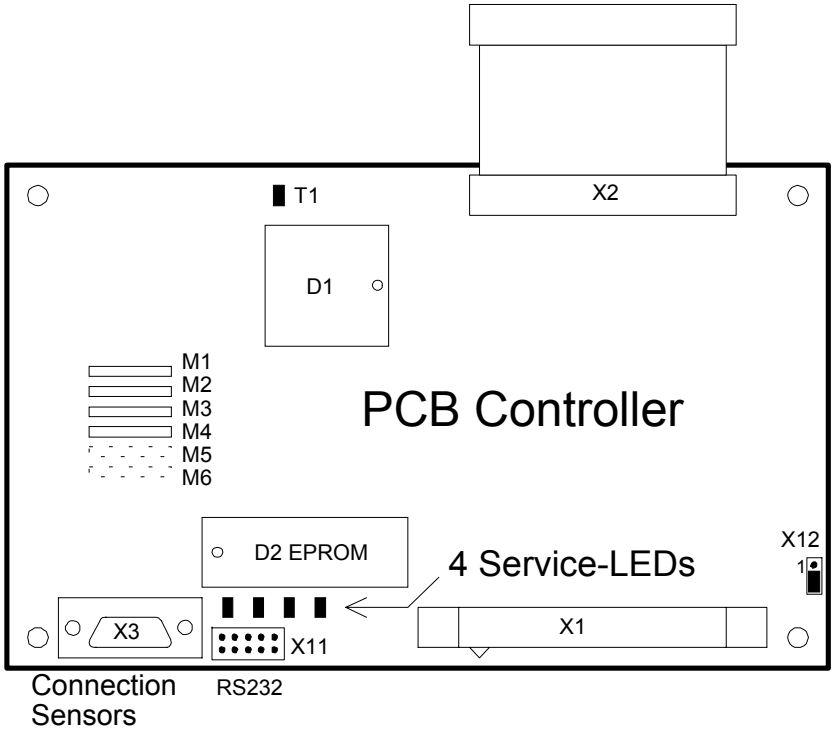
Important: Components can be effected by static electricity!

Position in electronics system:



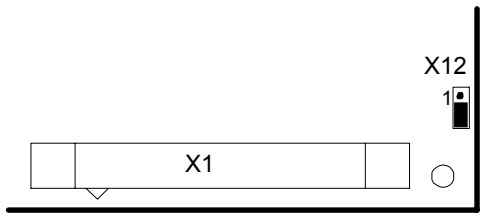
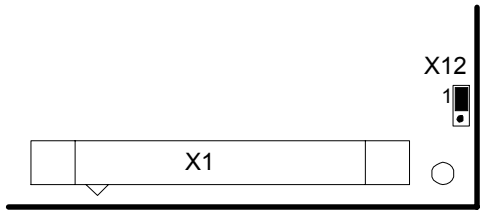
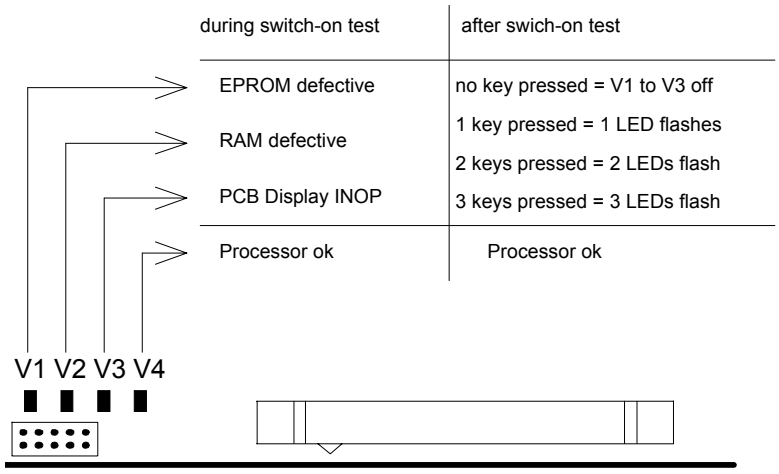
4.3.2 Controller PCB 82 90 668

Layout:



Components and jumpers:

Item	Component/function
X1	Connection to display PCB
X2	Connection to power PCB
X3	Connection to sensors of heating panel; refer to 3.2.1 for wiring diagram
X11	RS232 (not active)

Item	Component/function
X12	Call-up of service mode without keys Position in operation without jumper or jumper in park position 2-3:  Call-up of service mode. Short circuit for max. 30 seconds between 1-2: 
T1	Connection to housing (protective conductor)
D1	Microcontroller 68332 18 37 109
D2	EPROM, see 5. Repair information, software
M1 - M4	Temperature module 83 50 082
M5, M6	Not used
Service LEDs	

Important: There are no components on the controller PCB which have to be replaced at service intervals.

4.3.3 Testing controller PCB

4.3.3.1 Processor system

Following switch-on no INOP error message; LED V4 must light; refer to table in 4.3.2.

4.3.3.2 Measured value acquisition and heating control

Refer to 4.2.3 Testing of electronics, complete.

4.3.4 Replacement in repair situation

The following spare parts are available for repairs:

- Controller PCB (Babytherm) 82 90 668
  - o EPROM See 5.

Use in the type BF requires additional capacitors in the measurement input which cannot be retrofitted in the field. Retrofitting has already been performed if the modification number after the order no. is ³ 1.1, i.e. the PCB is marked with 82 90 688 - 1.1 or a higher modification number. Some units of type B already feature this modification.

Controller PCB 82 90 688 ≤ 1.0	**Controller PCB 82 90 688 ≥ 1.1**
Only for use in type B. Use in type BF could result in destruction of measurement input caused by the influence of voltage peaks	Can be used in types B and BF

4.3.5 Testing after replacement

Refer to 4.2.3 Testing electronics, complete

4.3.6 Repair information and modification statuses

4.3.6.1 Alteration of class type B to BF (12.94)

The future Standard for mattress heating IEC 601-2-35 (as at 12.94) prescribes that the resting surface is no longer to be earthed and that class type BF (Body Floating) must be used. The units are currently being supplied as type B (Body) i.e. with earthed resting surface. Production of the Babytherm 8000 with mattress heating is to be switched as of the start of 1995 to class type Typ BF; prior to this date roughly 300 units will be delivered with the old class type B.

Subsequent alteration from type B to BF is not envisaged.

Use in the type BF requires additional capacitors in the measurement input which cannot be retrofitted in the field. Retrofitting has already been performed if the modification number after the order no. is 1.1, i.e. the PCB is marked with 82 90 668 - 1.1 or a higher modification number. Some units of type B already feature this modification.

Controller PCB 82 90 668 ≤ 1.0	**Controller PCB 82 90 668 ≥ 1.1**
Only for use in type B. Use in type BF could result in destruction of measurement input caused by the influence of voltage peaks	Can be used in types B and BF

Important: A summary of class alteration from type B to BF is given in Section 9.3. Consult this Section in the event of doubt.

4.3.6.2 New EEPROM on Controller PCB 04.01

A new EEPROM on the Controller PCB P/N 8290668 requires the new software version 1.04. If a new Controller PCB is used with the previous software version error code 15 will be generated.

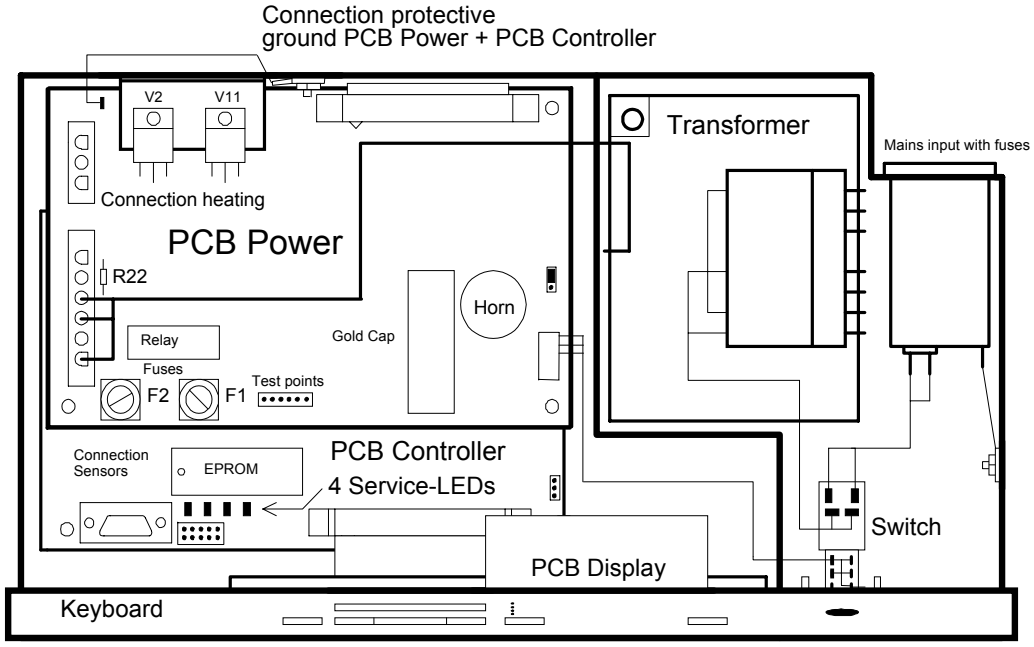
When replacing the Controller PCB P/N 8290668, software version 1.04 (P/N 2M22467) must be installed.

4.4 Power PCB

4.4.1 General information

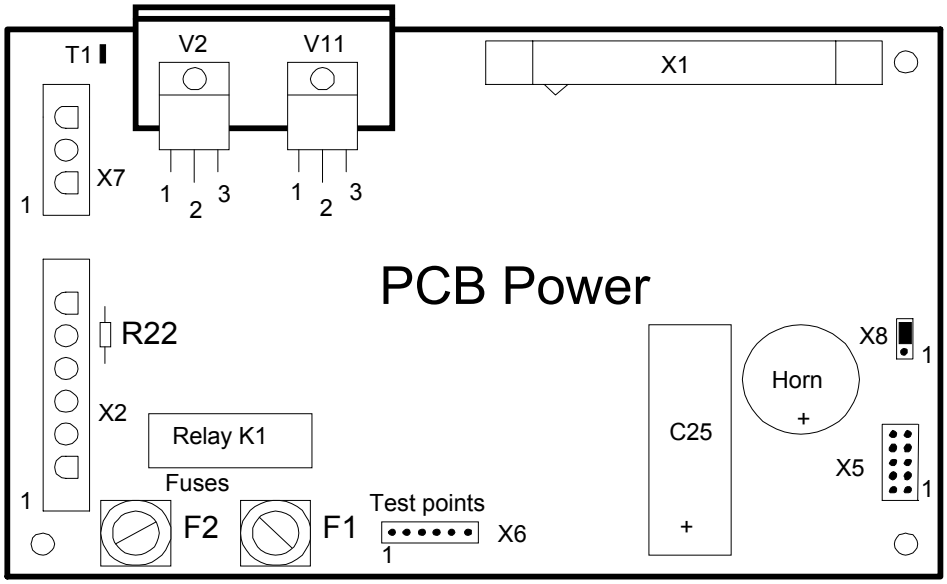
Important: Components can be effected by static electricity!

Position in electronics system:



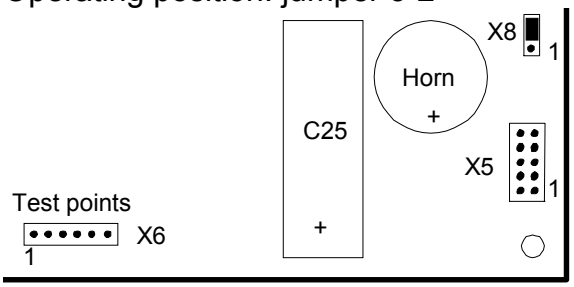
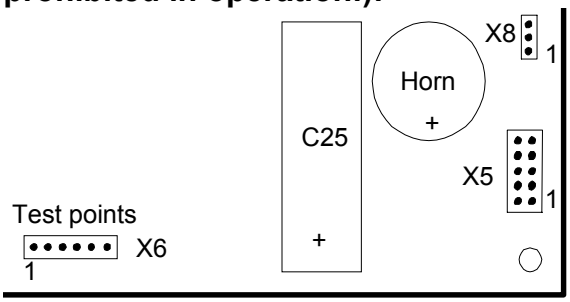
4.4.2 Power PCB 82 90 641

Layout:



Components and jumpers:

Item	Component/function
X1	Connection to controller PCB
X2	Connection to transformer
X5	Connection to auxiliary contacts in mains switch
X6	Test points: 1 = GND digital 2 = + 5 V digital 3 = Voltage, gold cap (battery) 4 = not used 5 = not used 6 = not used
X7	Connection, heating: 1 and 2 = Heating 3 = Protective conductor, heating panel

Item	Component/function
X8	Operating position: jumper 3-2  **Position without jumper or jumper 1-2 for "horn off" for service only (absolutely prohibited in operation!):** 
T1	Connection to housing (protective conductor)
F1	Fuse T 800 mA DIN 41662 18 15 075
F2	Fuse T 6.3 A DIN 41662 18 15 172
K1	Relay 5V / 8A 18 30 732
V2	Triac 600V / 8A 18 13 951
V11	Voltage regulator 5V 18 09 245 1 = In 2 = GNDD 3 = Out
C25	Gold cap 3.3F 18 36 986
Horn	Buzzer 18 24 880

Important: There are no components on the power PCB which have to be replaced at service intervals.

4.4.3 Testing power PCB

4.4.3.1 Supply voltages

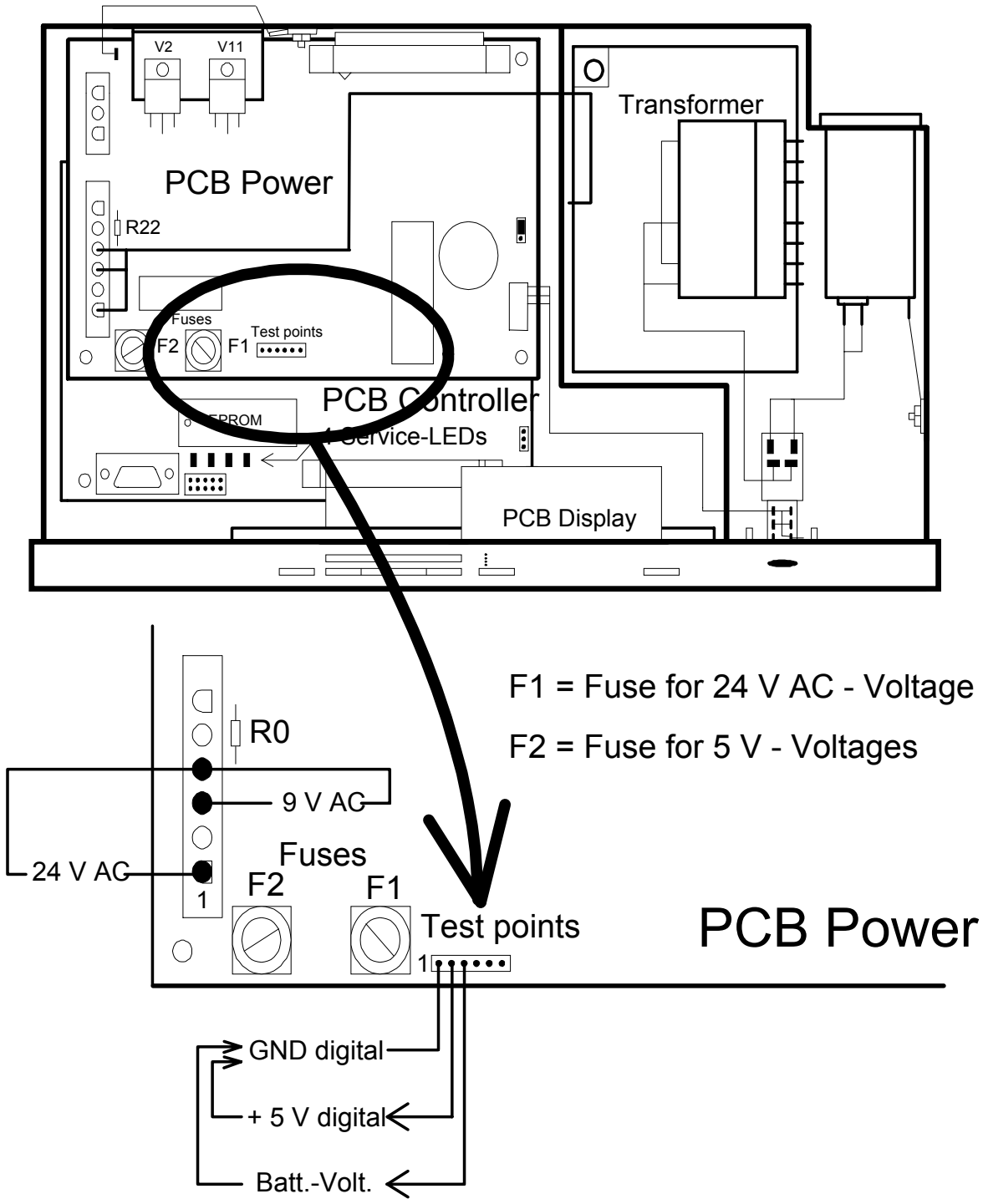
Preparation for testing:

- Interrupt mains connection to Babytherm
- Remove electronics assembly or pull it out of Babytherm
- Remove cover from electronics assembly
- Heating and sensors do not have to be connected
- Establish mains connection

Caution:

Parts under current (e. g. mains switch) may be touched by coincidance, therefore use insulation transformer.

Test set-up and measurement points:



Testing:

- Switch on unit

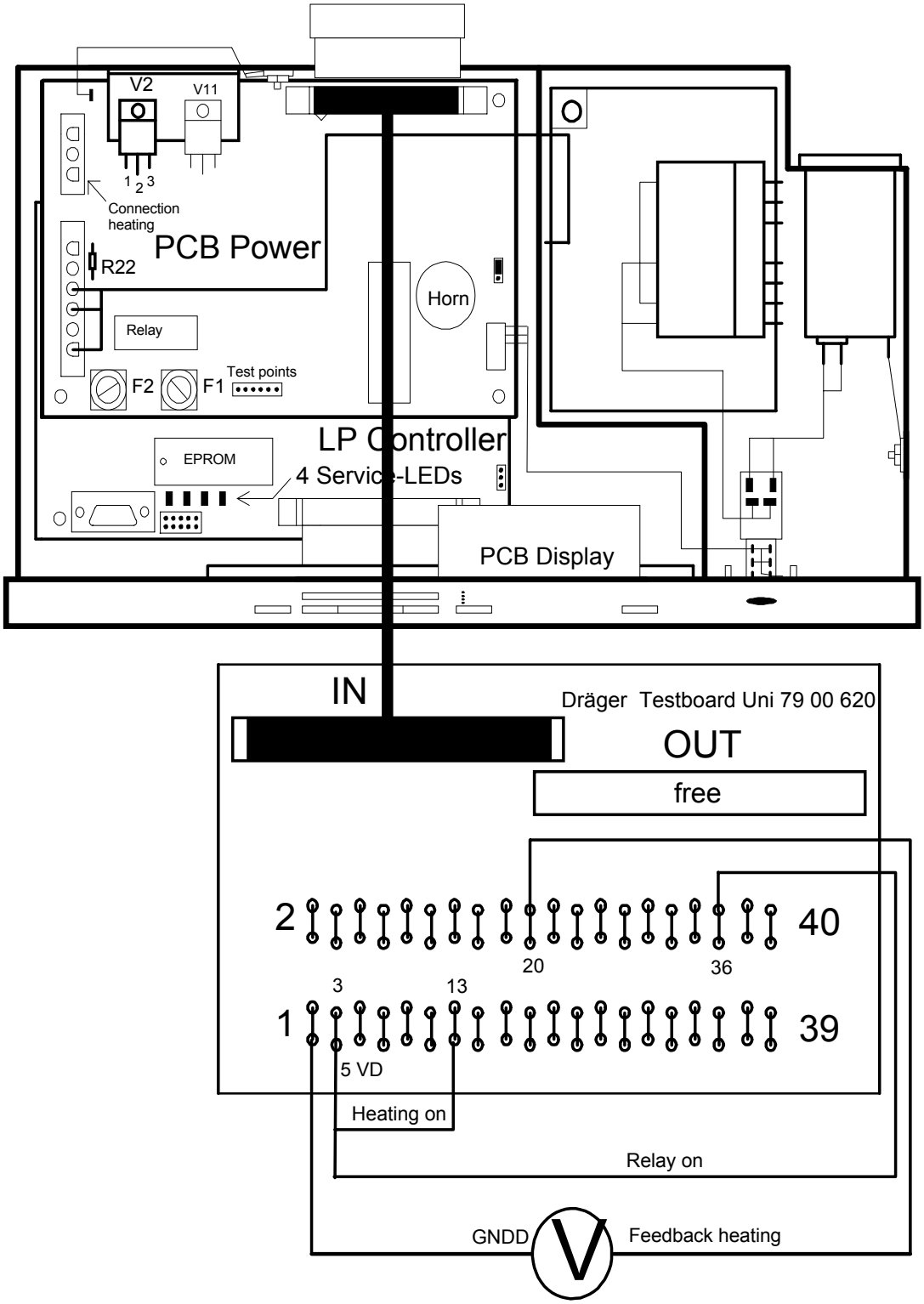
What	How	Test value	Possible faults
+ 5 V digital	Measure with multimeter between test points 2 and 1 (GNDD)	+ 5.0 ± 0.2 VDC	- Mains fuses defective - Fuse F2 defective - Voltage regulator defective - 9 VAC from transformer defective
Battery voltage	Measure with multimeter between test points 3 and 1 (GNDD) with mains connection	≥ 3.5 VDC	- Gold cap C25 defective - Gold cap C25 not charged (charging time approx. 15 min), because + 5V defective - Charging circuit for gold cap C25 defective
Battery voltage	Measure with multimeter between test points 3 and 1 (GNDD) without mains connection, however with device switched on	≥ 3.5 VDC	- Gold cap C25 defective, if previous test with voltage supply OK

4.4.3.2 Testing heating actuation, safety relay and heating feedback

Preparation for testing:

- Interrupt mains connection to Babytherm.
- Remove electronics assembly and heating panel with sensors from Babytherm.
- Remove cover from electronics assembly.
- Interrupt ribbon cable connection between power PCB and controller PCB; this involves disconnecting power PCB.
- Connect up Uni test board, complete 79 00 610 with 40-pin ribbon cable to power PCB.
- Connect up heating on power PCB.
- Establish mains connection:

Test set-up and measurement points:



Testing:

- Connect up multimeter on test board between TP 20 (heating feedback) and TP 1 (GNDD).

- Switch on unit.

  ⇒ Horn on (no significance)

  ⇒ Test voltage V < 1 V (low level = heating off)

- Create short circuit on test board between TP 3 (+ 5 VD) and TP 13 (heating on).

- Additionally create short circuit on test board between TP 3 (+ 5 VD) and TP 36 (relay on).

  ⇒ Test voltage V > 4 V (high level = heating on)

- Remove one short circuit in each case.

  ⇒ Test voltage always V < 1 V (low level)

4.4.3.3 Testing horn, acoustic mains failure alarm and mains-switch auxiliary contacts

Preparation for testing (as for 4.4.3.2, however heating and sensors do not have to be connected):

- Interrupt mains connection to Babytherm.

- Remove electronics assembly from Babytherm.

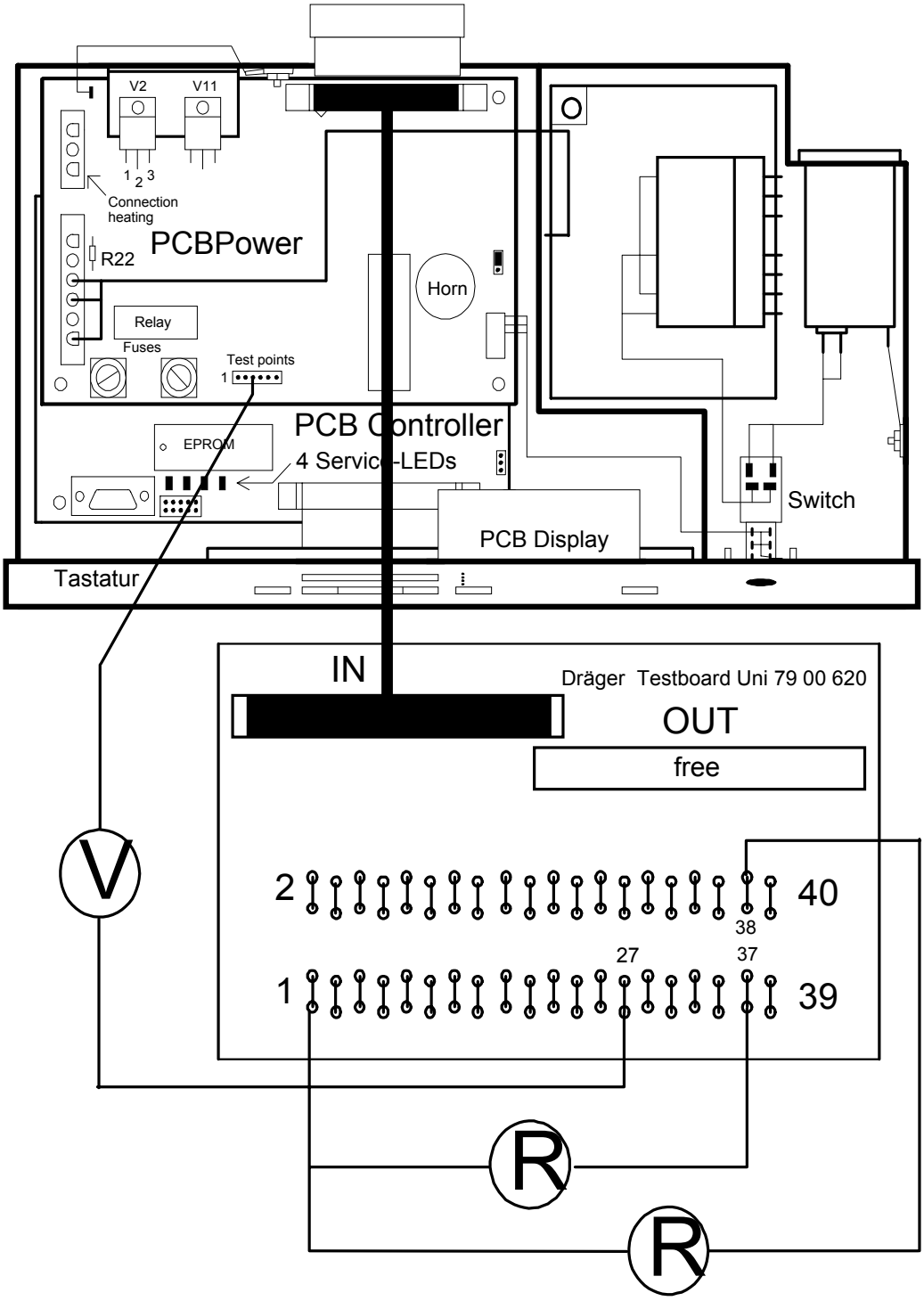
- Remove cover from electronics assembly.

- Interrupt ribbon cable connection between power PCB and controller PCB; this involves disconnecting power PCB.

- Connect up Uni test board complete 79 00 610 with 40-pin ribbon cable to power PCB.

- Establish mains connection.

Test set-up and measurement points:



Testing:

- Testing mains-switch auxiliary contacts (changeover switch):

Switch position	**Resistance measurement on test board between TP 1 (GNDD) and TP 37**	**Resistance measurement on test board between TP 1 (GNDD) and TP 38**
Off	R = ∞	R = 0 Ohms
On	R = 0 Ohms	R = ∞

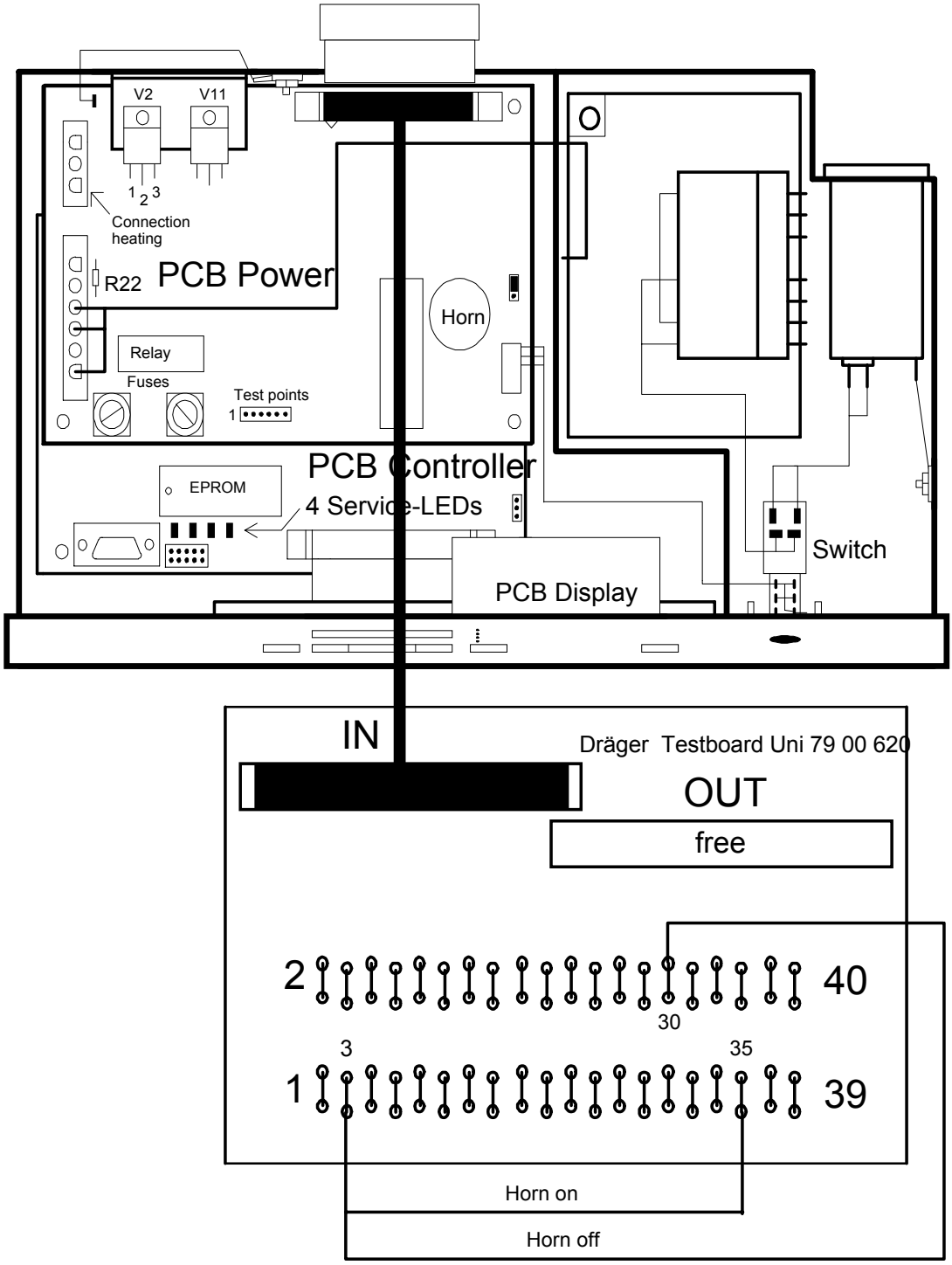
- Testing mains-switch auxiliary contacts (on/off switch):

Switch position	**Voltage measurement between TP 27 on test board and TP 3 on power PCB (X6)**	**Possible faults**
Off	V > 3.5 VDC	- Switch defective - Gold cap C25 defective - Gold cap C25 not charged because + 5V defective - Charging circuit for gold cap C25 defective
On	V ≈ 0 V	- Switch defective

- Testing horn and mains failure recognition:

  Prerequisite: Mains-switch auxiliary contacts OK

Test set-up and measurement points:



- Switch on unit

  ⇒ Horn on

- Create short circuit on test board between TP 3 (+ 5 VD) and TP 30 (horn off).

  ⇒ Horn off

- Interrupt mains connection but do not switch off unit.

  ⇒ Horn on (delay time due to monoflop)

- Reestablish mains connection

  ⇒ Horn off

- Additionally create short circuit on test board between TP 3 (+ 5 VD) and TP 35 (horn on).

  ⇒ Horn on

4.4.3.4 Testing visual mains failure alarm

Prerequisite: mains-switch auxiliary contacts OK.

- Assemble unit ready for operation
- Create mains connection
- Switch on unit
- Interrupt mains connection

  ⇒ Visual and acoustic mains failure alarm

4.4.4 Replacement in repair situation

The following spare parts are available for repairs:

-	Power PCB, complete (see TSB # 4 or IDM # 5)	82 90 771
o	Relay 5V / 8A	18 37 001
o	Fuse T 800 mA	18 15 075

- Fuse T 6.3 A 18 15 172

4.4.5 Testing after replacement

The following checks are to be carried out after performing repairs on the power PCB or after replacing the power PCB:

- Visual checks:
  - Jumper fitted on X8 position 2-3 (see 4.4.2 Layout).
  - Correct connection of all cables for power PCB (see 4.1.3 Wiring diagram).
  - Heat sink attached to housing by way of screw connection.
- Electrical safety check
- Functional check (Test duration at least 20 minutes)
  - Function of heating
  - Mains failure alarm
  - Data storage with mains failure alarm
  - Function of keys
  - Function of display elements
  - No error messages

4.5 Display PCB

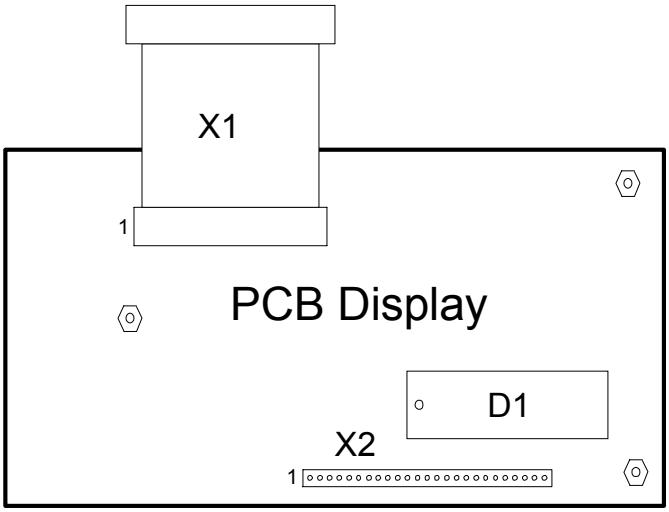
4.5.1 General information

Important: Components can be effected by static electricity!

The display PCB contains the 7-segment displays and their actuation systems. The display PCB likewise actuates the LEDs "40°C", "±1°C", ">37°C/<35°C" and "horn off" on the keypad in addition to reading in all keys.

4.5.2 Display PCB

Layout:



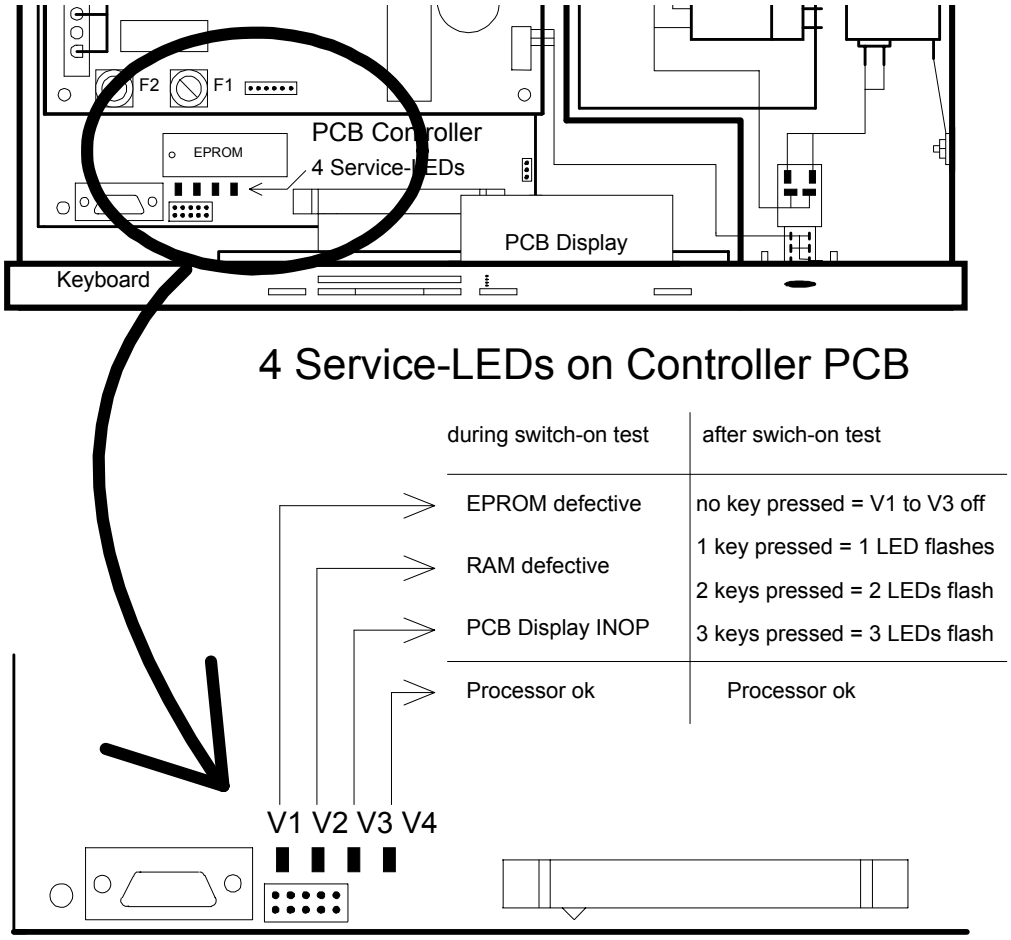
Components:

Item	Component/function
X1	Connection to controller PCB
X2	Connection to keypad
D1	Keypad and display driver 18 20 877

4.5.3 Testing display PCB

4.5.3.1 Testing read-in of keys

Following successful switch-on test, every actuation of a key is displayed by the service LEDs on the controller PCB. Important: a jumper on the controller PCB X12 at position 1-2 (call-up of DS mode without keys) is classed as a key being pressed (refer also to 4.3.3).



Refer also to testing of keypad under 4.8.3.2.

4.5.3.2 Testing displays and LEDs in situ

Prerequisite: "Check" key OK (see 4.5.3.1).

Press "Check" key during operation:

⇒ All LEDs (and horn) are actuated for one second; "88.8" appears on the 7-segment displays.

Possible faults:

Display	Possible faults
LEDs "40°C", "±1°C", ">37°C/<35°C" and "horn off" defective (off or flash); 7-segment displays not OK	- Display PCB defective

LED "40°C", "±1°C", ">37°C/<35°C" and "horn off" off; 7-segment displays OK	- Display PCB defective (actuation of LEDs) - Keypad defective (cable break in joint GND of these LEDs)
One - three of the LEDs "40°C", "± 1°C", ">37°C/<35°C", or "horn off" off; 7-segment displays OK	- Keypad defective (LED or cable break)

Refer also to testing of keypad LEDs "40°C", "±1°C", ">37°C/<35°C" under 4.8.3.3.

4.5.4 Replacement in repair situation

The following spare parts are available for repairs:

- Display PCB 82 90 611
- Keypad and display driver 18 20 877

4.5.5 Testing after replacement

The following tests are to be performed after replacing the keypad:

- Visual checks:
  - o Display PCB correctly installed
- Electrical safety check
- Functional check:

  Test duration at least 20 minutes
  - o Function of keys
  - o Function of displays
  - o Mains failure alarm
  - o Data storage with mains failure alarm
  - o No error messages

4.6 Mains switch

4.6.1 General information

The mains switch consists of four switches:

- 2 on/off switches for mains voltage
- 1 on/off switch for horn actuation in the event of mains failure
- 1 changeover switch for mains failure recognition

4.6.2 Mains switch

For connection of mains switch refer to 4.1.3 Wiring diagram.

4.6.3 Testing of mains switch

4.6.3.1 Testing of mains contacts

Testing is performed by measuring the mains voltage upstream and downstream of the mains contacts (see 4.1.3 Wiring diagram).

4.6.3.2 Testing of auxiliary contacts

Refer to 4.4.3.3 Power PCB; Testing mains-switch auxiliary contacts

4.6.4 Replacement in repair situation

The following spare parts are available for repairs:

-	Wiring harness, mains 220/240V	82 01 795
o	Mains switch	83 01 781
o	Knob for mains switch	83 02 369

4.6.5 Testing after replacement

The following tests are to be performed after replacing the keypad:

- Visual checks
  - o Mains switch correctly installed (see also 4.1.3 Wiring diagram)

- Electrical safety check
- Functional check:

  Test duration at least 20 minutes.

  - o Function of keys
  - o Function of displays
  - o Mains failure alarm
  - o Data storage with mains failure alarm
  - o No error messages

4.7 Transformer

4.7.1 General information

The transformer uses the mains voltage to generate the AC voltages required for operation (9 V for electronics and 24 V for resting-surface heating). The transformer is provided with a thermal release.

4.7.2 Technical data of transformer

- Input, primary:
  - o 2 x 100 V
  - o 2 x 120 V
- Output, secondary:
  - o 24 V / 6.7 A with centre tap 9 V
- Frequency:
  - o 50 / 60 Hz

Ambient temperature:

- o max. 45 °C

Limit temperature:

- o 165 °C under overload condition

Thermo-switch:

- o Efen 4257A

4.7.3 Testing of transformer

For testing of output voltages refer to 4.4.3.1 Power PCB, testing of supply voltages.

Caution:
If the thermal release on the transformer has tripped, a check is to be made as to whether the heating actuation on the power PCB only switches through whole sinusoidal waves. This means that if a sinusoidal wave is commenced with positive voltage pass, it must be ended with the negative voltage pass!
Testing is performed by taking measurements with an oscilloscope instead of a multimeter as described under 4.4.3.2 "Testing triac and triac actuation"; the triac is only to be actuated for an extremely brief period of time.

The transformer cannot be repaired.

4.7.4 Replacement in repair situation

The following spare part is available for repairs:

- Transformer 82 01 796

4.7.5 Testing after replacement

The following tests are to be performed after replacing the keypad:

- Visual checks
  - o Transformer correctly installed (see also 4.1.3 Wiring diagram)
- Test output voltages of transformer
- Electrical safety check

- Functional check(Test duration at least 20 minutes)
  - o Function of keys
  - o Function of displays
  - o Mains failure alarm
  - o Data storage with mains failure alarm
  - • No error messages

4.8 Keypad

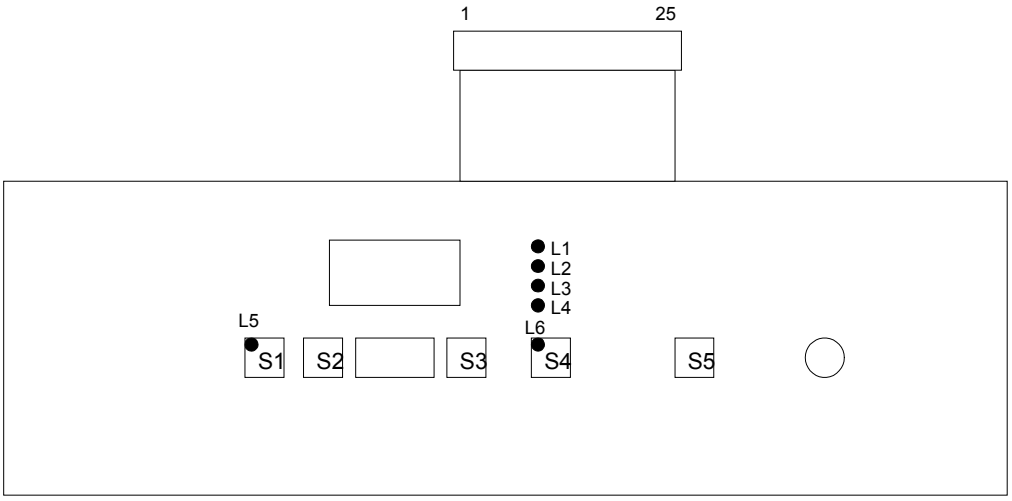
4.8.1 General information

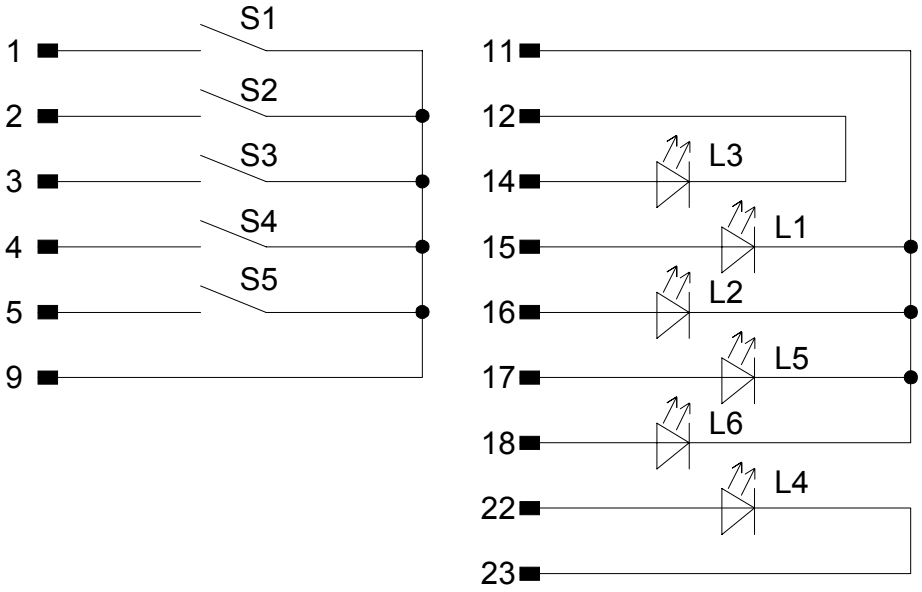
The keypad contains:

- 5 touch-sensitive keys
- 6 LEDs

4.8.2 Keypad 2M 20 885

Layout:





Components and function:

Component	Function
S1	Touch-sensitive key ">37°C/<35°C" read in by display PCB
S2	Touch-sensitive key "negative setpoint" read in by display PCB

S3	Touch-sensitive key "positive setpoint" read in by display PCB
S4	Touch-sensitive key "horn off" read in by display PCB
S5	Touch-sensitive key "check" read in by display PCB

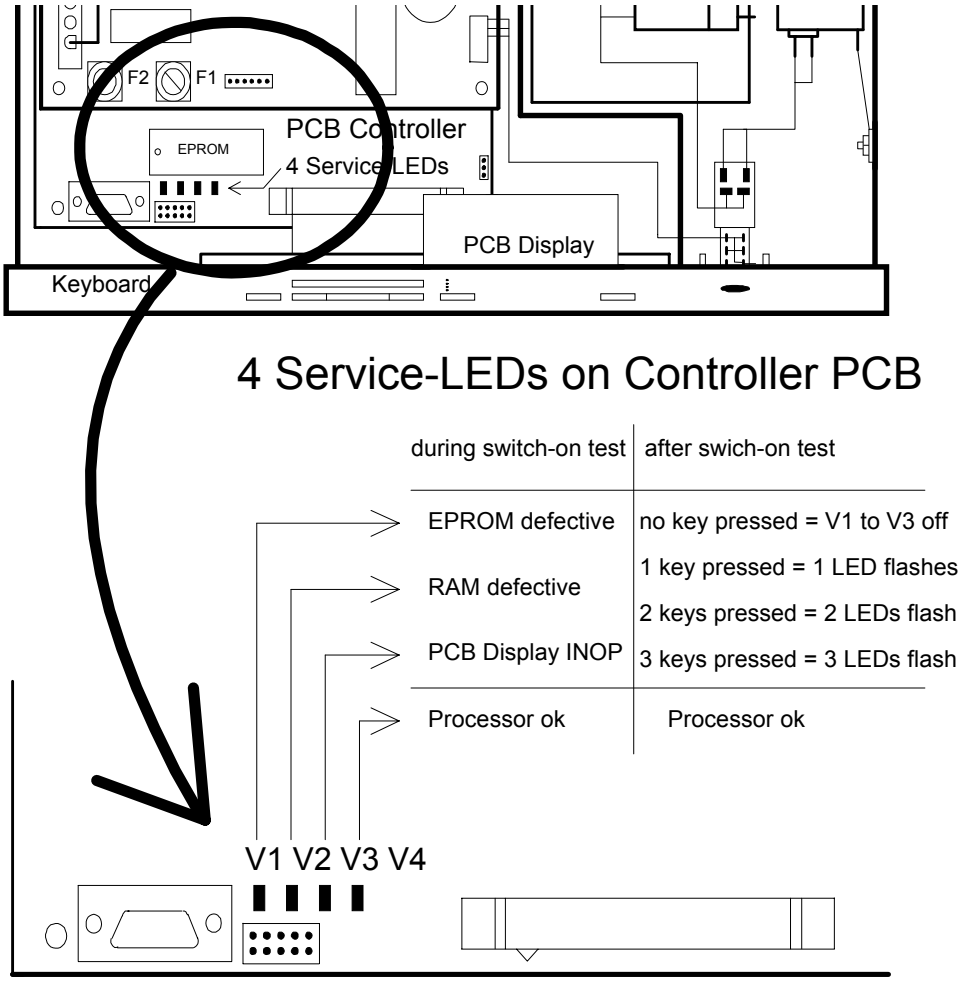
Component	Function
L1	LED "40°C", red, actuated by display PCB
L2	LED "±1°C", red, actuated by display PCB
L3	LED "Inop.", red, actuated by controller PCB
L4	LED "power failure", red, actuated by power PCB
L5	LED ">37°C/<35°C", yellow, actuated by display PCB
L6	LED "horn off", yellow, actuated by display PCB

The keypad cannot be repaired.

4.8.3 Testing of keypad

4.8.3.1 Testing of keys in situ

Following successful switch-on test, every pressing of a key is indicated by the service LEDs on the controller PCB. Important: a jumper on the controller PCB X12 in position 1-2 (call-up of DS mode without keys) is classed as pressing of a key (see also 4.3.3).



4.8.3.2 Testing keys with keypad removed

The keys can be ohmically checked at the keypad connector (see layout under 4.8.2).

Switch condition, key	Resistance
Key not pressed	R = ∞
Key pressed	R ≤ 100 ohms

4.8.3.3 Testing LEDs in situ

Prerequisite: Key "check" and display PCB OK, see 4.8.3.1.

Press "check" key during operation:

⇒ All LEDs and (horn) are actuated for 1 second; "88.8" appears on the 7-segment displays.

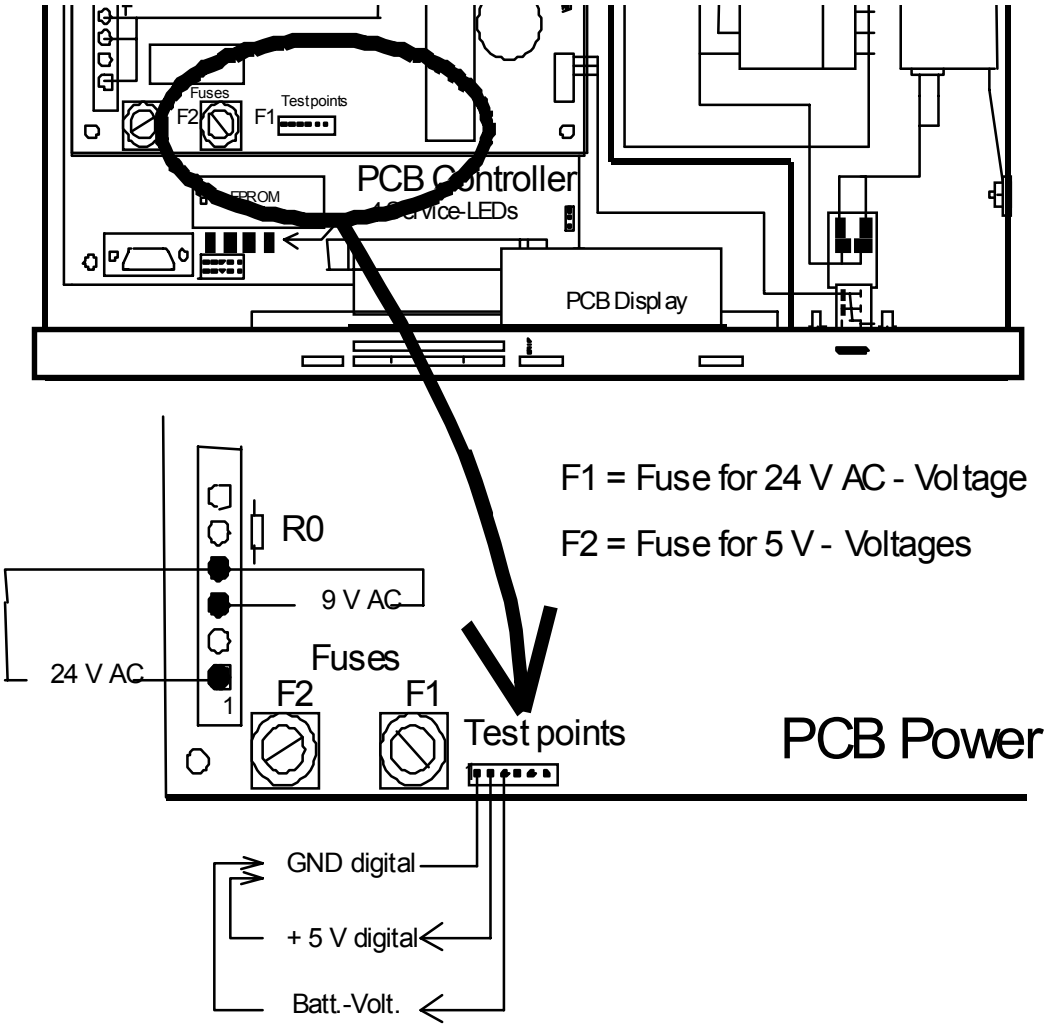
Possible faults:

Display	Possible faults
LEDs "40°C", "±1°C", ">37°C/<35°C" and "horn off " defective (off or flash), 7-segment displays not OK	- Display PCB defective
LED "40°C", "±1°C", ">37°C/<35°C" and "horn off" off, 7-segment displays OK	- Display PCB defective (actuation of LEDs) - Keypad defective (cable break in joint GND of these LEDs)
One - three of LEDs "40°C", "±1°C", ">37°C/<35°C" or "horn off" off, 7-segment displays OK	- Keypad defective (LED(s) defective or cable break)
LED "horn off" off, horn on	- Keypad defective (LED defective or cable break) - Actuation transistor on power PCB defective
LED "horn off" and horn off	- Power PCB defective
LED "Inop." off	- Keypad defective (LED defective or cable break) - Controller PCB defective (actuation)

4.8.3.3 Testing LEDs with keypad removed

- Electronics assembly is ready for operation, however cable connection between display PCB and keypad detached.

- Testing is performed by supplying current from test points 2 "+ 5 V digital" and 1 "GNDD" on power PCB to contacts of LEDs at keypad connector (see 4.8.2 Layout). Caution: Only current from these test points is permitted since the test point is safeguarded by a 14 Kohm resistor.



- Each LED is to be checked individually. The LEDs only light very dimly on account of the low current; the room may have to be darkened. "+" is fed in in each case at the anodes of the LEDs (pins 14, 15, 16, 17, 18 or 22).

4.8.4 Replacement in repair situation

The following spare part is available for repairs:

- Keypad 2M 20 885

4.8.5 Testing after replacement

The following tests are to be performed after replacing the keypad:

- Visual checks
  - o Keypad and connecting cable correctly installed
- Electrical safety check
- Functional check:

  Test duration at least 20 minutes.
  - o Function of keys
  - o Function of display elements
  - o Mains failure alarm
  - o Data storage with mains failure alarm
  - o No error messages

4.9 Mains input

4.9.1 General information

The mains-input assembly features the following functions:

- Power cord connector
- Accommodation of both mains fuses
- Mains filter

4.9.2 Replacement in repair situation

The following spare parts are available for repairs:

- Mains filter (mains input) 18 18 384
  - o 220/240V units:
    2 x fuse DIN 41662, T800mA 18 15 075
  - o 100/127V units:
    2 x fuse DIN 41662, T1.6A 18 15 105
- Euro power cord 2M 21 220

4.9.3 Testing after replacement

The following tests are to be performed after replacing the mains input:

- Visual checks
  - o Connecting cable correctly installed
- Electrical safety check:
- Functional check (Test duration at least 20 minutes)
  - o Function of keys
  - o Function of display elements
  - o Mains failure alarm
  - o Data storage with mains failure alarm
  - o No error messages

4.10 Heating and sensor adapters

4.10.1 General

The heating and sensor adapters are the two cable connections between the PCBs and the cover of the mattress heating control.

The adapters differ depending on class type B or BF.

4.10.2 Differences between class type B and BF

Type B	Type BF
Wiring harness Heating adapter 2M 21 096 3-pin adapter cable without ferrite between heating connection on housing cover and power PCB.	Wiring harness Heating adapter 2M 21 507 2-pin adapter cable with ferrite between heating connection on housing cover (2-pin) and power PCB (3-pin).
Wiring harness Sensor adapter 2M 21 094 Wiring harness with ferrite 18 31 577 between sensor connection on housing cover and controller PCB. This cable can also be used in type BF.	Wiring harness Sensor adapter 2M 21 508 Wiring harness without ferrite between sensor connection on housing cover and controller PCB

4.10.3 Replacement in the event of repair

These components are not envisaged as S-parts.

4.10.4 Repair information and modification statuses

4.10.4.1 Alteration of class type B to BF (12.94)

The future Standard for mattress heating IEC 601-2-35 (as at 12.94) prescribes that the resting surface is no longer to be earthed and that class type BF (Body Floating) must be used. The units are currently being supplied as type B (Body) i.e. with earthed resting surface. Production of the Babytherm 8000 with mattress heating is to be switched as of the start of 1995 to class type Typ BF; prior to this date roughly 300 units will be delivered with the old class type B.

Subsequent alteration from type B to BF is not envisaged.

The mattress heating controls 220/240V for types B and BF have different order numbers.

Type B	Type BF
Mattress heating control 2M 20 880 Distinguishing feature: - 3-pin heating connection	Mattress heating control 2M 21 500 Distinguishing features: - 2-pin heating connection - Order no. printed on - Marked "BF"
RAT mattress heating control 2M 21 095	RAT mattress heating control 2M 21 506

Important: The control system 2M 20 880 and the RAT (repair/replacement) control system 2M 21 095 for type B will no longer be available in future.

Type BF controls are to be ordered as spare part for the old type B. On installation, merely the housing cover with the two wiring harnesses (heating adapter and sensor adapter) is to be taken over from the defective control system. The marking on the housing of the new control system is to be changed to type B and the order no. from 2M 21 500 to 2M 20 880.

There is no change to the cable connections between the PCBs. The only alteration is to the wiring harnesses (sensor adapter and heating adapter), i.e. the two cable connections from the cover to the PCBs.

Type B	Type BF
Wiring harness Heating adapter 2M 21 096 3-pin adapter cable without ferrite between heating connection on housing cover and power PCB.	Wiring harness Heating adapter 2M 21 507 2-pin adapter cable with ferrite between heating connection on housing cover (2-pin) and power PCB (3-pin).
Wiring harness Sensor adapter 2M 21 094 Wiring harness with ferrite 18 31 577 between sensor connection on housing cover and controller PCB. This cable can also be used in type BF.	Wiring harness Sensor adapter 2M 21 508 Wiring harness without ferrite between sensor connection on housing cover and controller PCB

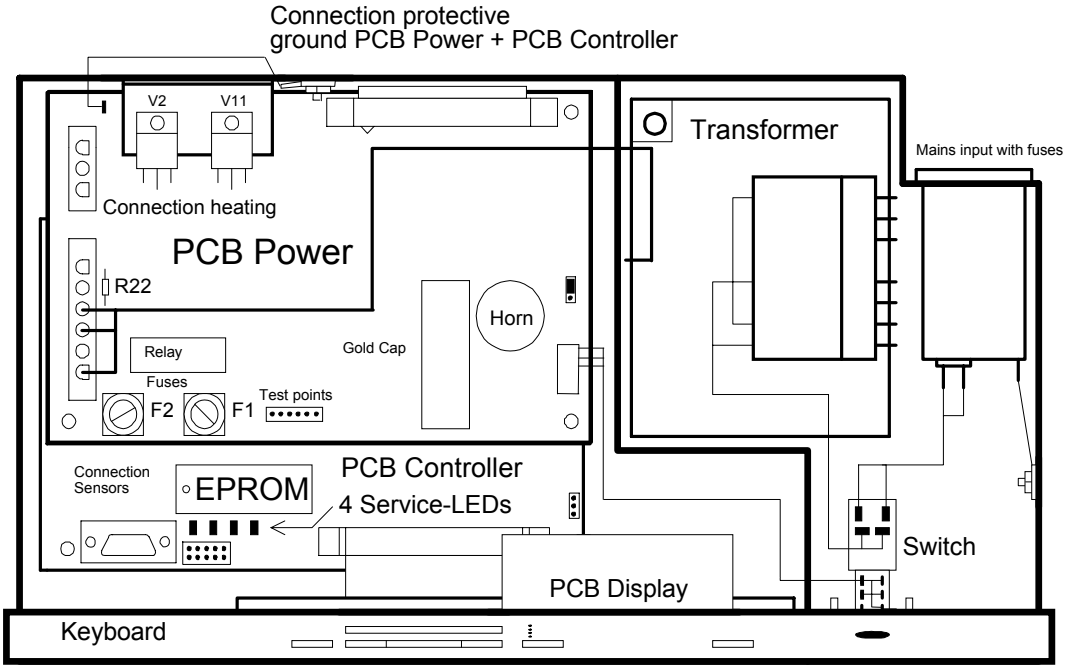
Important: A summary of class alteration from type B to BF is given in Section 9.3. Consult this Section in the event of doubt.

5. Mattress heating software

5.1 Software versions

The program is stored in an EPROM on the controller PCB.

Position in electronics system after opening electronics assembly:



The following software is envisaged:

-	Software 1.00 / 1.01 mattress heating	not allowed
-	Software 1.02 mattress heating	no longer available
-	Software 1.04 mattress heating	2M 22 467

5.2 Testing after replacement

See 4.2, however not including test with Babytherm 8000 test plug.

6. Troubleshooting - mattress heating

6.1 General information

The DS mode contains the following functions:

- Error list:

  Whenever an error is detected, an error number is stored in an error list together with the error frequency (max. 15). The error list can be read out and deleted.

- Diagnosis mode:

  The following can be implemented in diagnosis mode:

  - o Readout and setting of elapsed time meter
  - o Readout of all A/D converter channels and mono-times
  - o Actuation of safety relay and heating

- 4 Service LEDs on Controller PCB

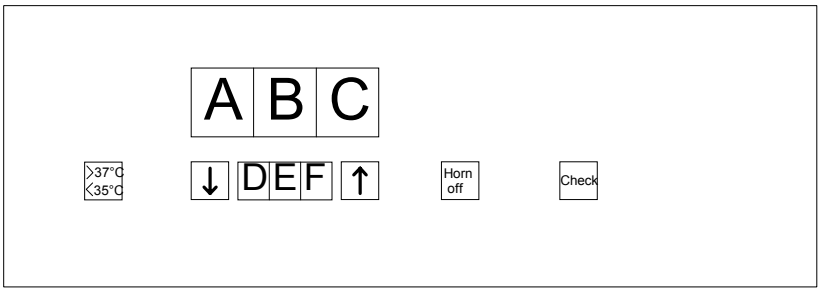
  - o One LED indicates status of processor
  - o Three LEDs are assigned various functions depending on operating status

6.2 Usage instructions for DS mode

6.2.1 Call-up of DS mode

Call-up is possible at all times during operation even with INOP.
There are two possibilities:

- Call-up via keys:

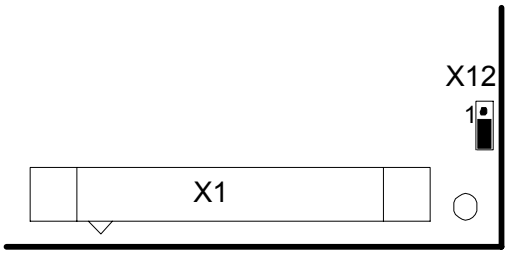


Press both "Silence" and "negative temp." keys for four seconds during operation.

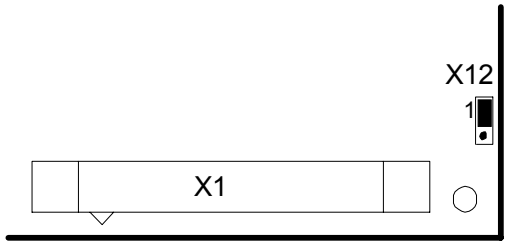
- Call-up without keys

Call-up is effected via a short-circuit produced for approximately 1 s for example by way of a jumper on the controller PCB after the self-test.
Important: Error message after 30 s with sustained short circuit.

Position in normal operation without jumper or jumper in park position 2-3:



Call-up of service mode. Short circuit for max. 30 seconds between 1-2:



6.2.2 Error list ⇔ Diagnosis mode switching

The unit is in the error list after calling up DS mode.

The key "<35 °C/>37 °C" can be employed at any time to switch between error list and diagnosis mode.

6.2.3 Exit from service mode

It is possible to exit from service mode at any time by:

- jointly pressing the keys "horn off" and "negative temp." for more than 2 s

  or by

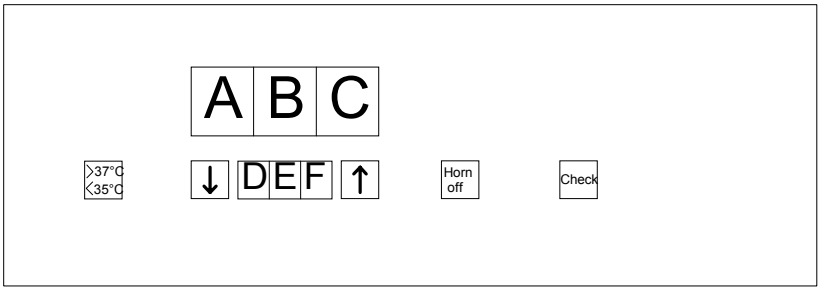
- switching off the unit

6.3 Diagnosis mode

The scope of the diagnosis mode is as follows:

6.3.0	Mode 0	Output of software version
6.3.1	Mode 1	Readout of temperature channel 1 (Vin0)
6.3.2	Mode 2	Readout of temperature channel 2 (Vin1)
6.3.3	Mode 3	Readout of temperature channel 3 (Vin2)
6.3.4	Mode 4	Readout of temperature channel 4 (Vin3)
6.3.5	Mode 5	Free temperature channel 5 (Vin4)
6.3.6	Mode 6	Free temperature channel 6 (Vin5)
6.3.7	Mode 7	Gold cap voltage (Vin 6)
6.3.8	Mode 8	AD test channel (Vin 7)
6.3.9	Mode 9	Output of watchdog 1 time
6.3.A	Mode A	Output of watchdog 2 time
6.3.b	Mode b	Switch-on and switch-off, safety relay
6.3.C	Mode C	Switch-on and switch-off, heating and readout of heating status feedback
6.3.d	Mode d	Position of mains switch
6.3.E	Mode E	Readout and setting of elapsed time meter

6.3.0 Mode 0 Output of software version



F = Mode number 0 flashing

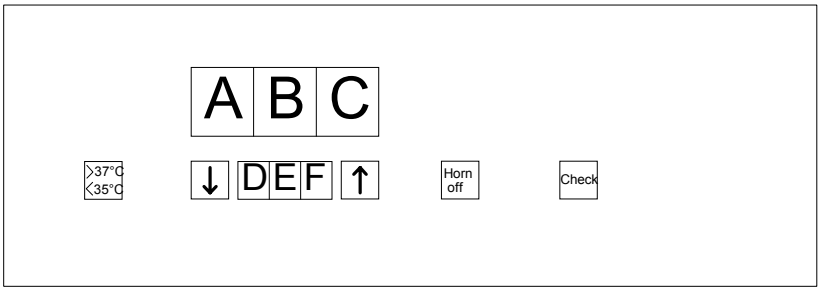
A . B C = Software version

The mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.1 Mode 1 Readout of temperature channel 1 (Vin0)

Output of temperature channel 1 (Vin0) in °C, testing of excess temperature "ANASW1" and readout of switching status of excess temperature comparator (UETEMPQ).



F = Mode number 1 flashing

A B , C = Temperature in °C without 1.0 °C offset subtracted during operation

D = Switching status, excess temperature comparator
- 0 = No excess temperature
- 1 = Excess temperature detected

Press key "check":

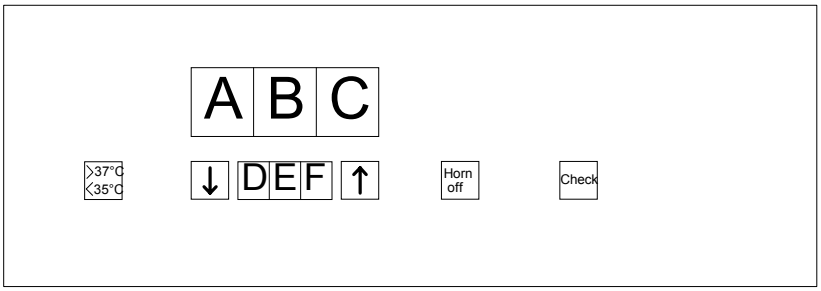
Display A B , C = 41.6 ± 0.2 °C and D = 1

The mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.2 Mode 2 Readout of temperature channel 2 (Vin1)

Output of temperature channel 2 (Vin1) in °C.



F = Mode number 2 flashing

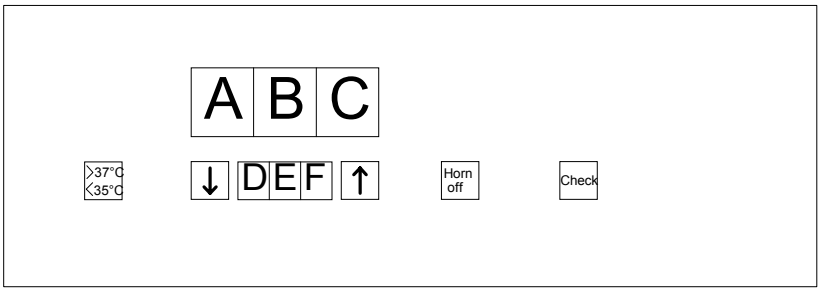
A B , C = Temperature in °C without 1.0 °C offset subtracted during operation

The mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.3 Mode 3 Readout of temperature channel 3 (Vin2)

Output of temperature channel 3 (Vin2) in °C, test for excess temperature "ANASW2" and readout of switching status of excess temperature comparator (UETEMPQ).



F = Mode number 3 flashing

A B , C = Temperature in °C without 1.0 °C offset subtracted during operation

D = Switching status of excess temperature comparator
0 = No excess temperature
1 = Excess temperature detected

Press key "check":

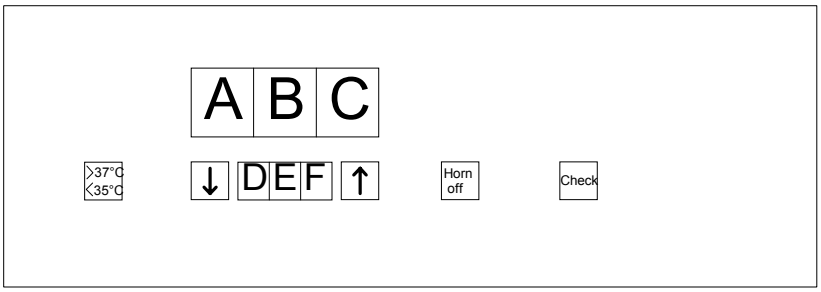
Display A B , C = 41.6 ± 0.2 °C and D = 1

The mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.4 Mode 4 Readout of temperature channel 4 (Vin3)

Output of temperature channel 4 (Vin3) in °C.



F = Mode number 4 flashing

A B , C = Temperature in °C without 1.0 °C offset subtracted during operation

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.5 Mode 5 Free temperature channel 5 (Vin4)

Optional channel not used at present ⇒ ignore

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.6 Mode 6 Free temperature channel 6 (Vin5)

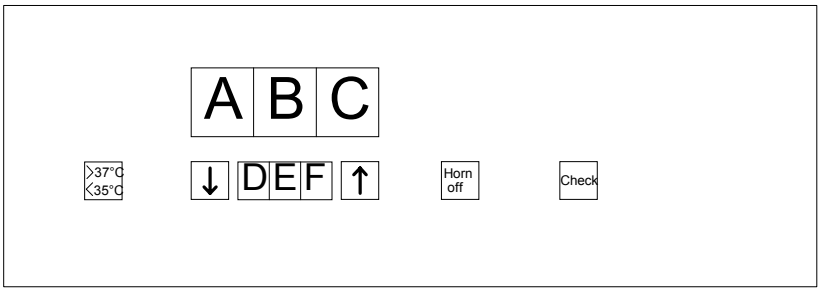
Optional channel not used at present ⇒ ignore.

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.7 Mode 7 Gold cap voltage (Vin 6)

Output of gold cap voltage from power PCB measured by controller PCB (Vin6) and deactivation of charging voltage.



F = Mode number 7 flashing

A , B C = Gold cap voltage in V

D = Charging voltage yes/no
0 = No charging voltage
1 = Charging voltage present

Gold cap voltage with charging voltage (D = 1):

A ; B C ≥ 3.5 V

Gold cap voltage without charging voltage (D = 0); to do so press key "check":

A ; B C ≥ 3.5 V

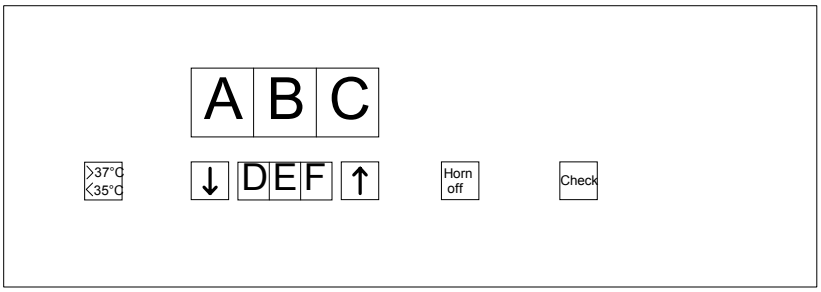
Important: Charging time is approx. 15 minutes.

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.8 Mode 8 AD test channel (Vin 7)

Output of voltage, AD test channel (Vin 7).



F = Mode number 8 flashing

A , B C = Voltage in V, test value = 5.0 ± 0.2 V

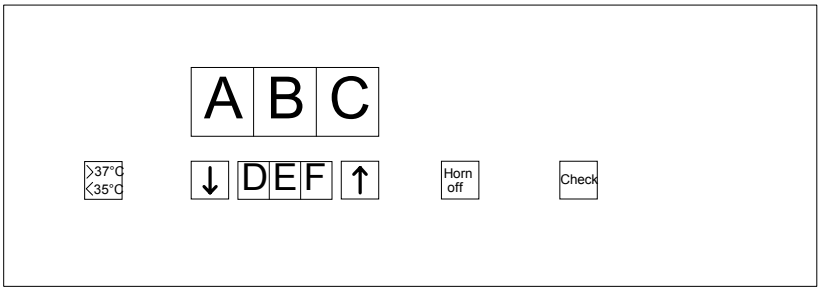
This voltage is formed from + 5 V digital, + 5 V analog and the reference voltage for the A/D converter; it corresponds to the voltage of 0.39 ± 0.02 V at the input of the A/D converter.

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.9 Mode 9 Output of watchdog 1 time

Output of watchdog 1 time in ms.



F = Mode number 9 flashing

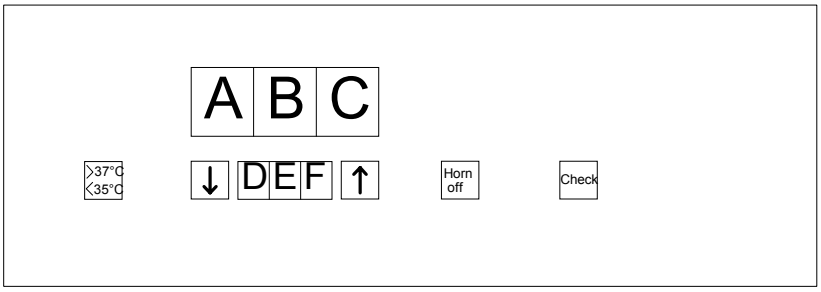
A B C = Mono-time in ms, set value = 250 ± 3 ms

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.A Mode A Output of watchdog 2 time

Output of watchdog 2 time in ms.



F = Mode number A flashing

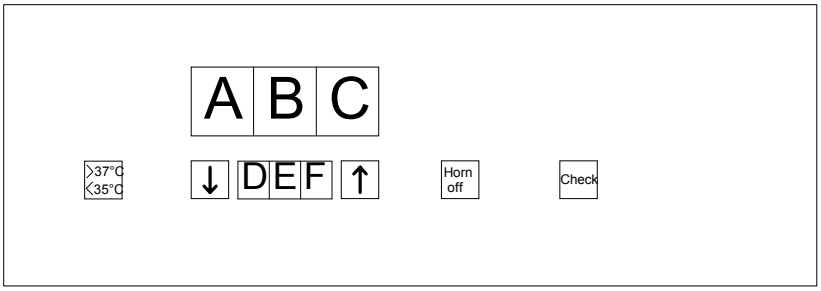
A B C = Mono-time in ms, set value = 250 ± 3 ms

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.b Mode b Switch-on and switch-off of safety relay

Mode for switching on and switching off safety relay on power PCB with "check" key. The switching status is indicated and is retained until exit from diagnosis mode is executed or until mode 1 or 3 is called up.



F = Mode number b flashing

A B C = rEL as flag for relay

D = Check-back signal of independent excess temperature deactivation path 41.6 °C
1 = Relay on (no excess temperature)
0 = Relay off (excess temperature)

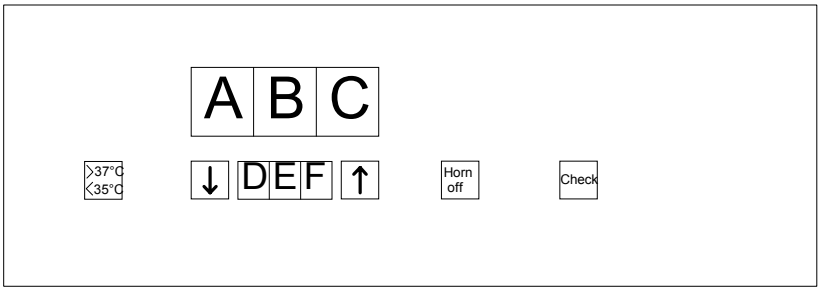
The relay can be deactivated with the "check" key by setting excess temperature.

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.C Mode C Switch-on and switch-off of heating and readout of heating status feedback

Mode for switching on and switching off heating and readout of heating status feedback



F = Mode number C flashing

A B C = HEA as flag for heater (heating)

D = Request, switching status, heating
0 = Heating off
1 = Heating on

E = Heating feedback

0 = Heating off detected
1 = Heating on detected

The heating can be switched on only in this mode for max. 60 s with the "check" key. This causes the heating to be clocked (1 s on and 0.5 s off).

Heating test:

- Switch on safety relay in mode b.

- Switch on heating in mode C:

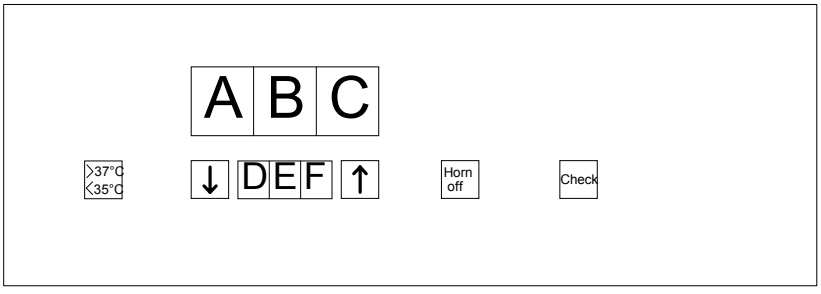
  Alternating feedback E = 1 and 0 (in mode C)

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.d Mode d Position of mains switch

Readout of position of mains-switch auxiliary contacts for warm/cold-start recognition.



F = Mode number d flashing

A B C = P F S as flag for power fail switch

D = Position of mains-switch auxiliary contacts

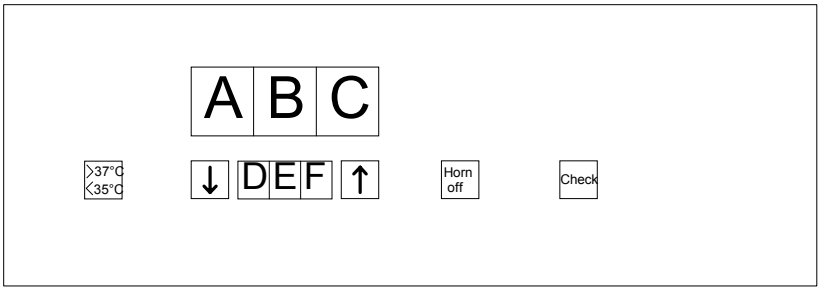
0	=	Fault on account of off position in operation
1	=	Normal on account of on position in operation

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.3.E Mode E Readout and setting of elapsed time meter

Output of operating hours with possibility of adjustment.



F	=	Mode number E flashing
A B C D E	=	Operating hours

Operating hours can be adjusted with keys "horn off" and "check":

Key "horn off"	⇒	Selection of digit A, B, C, D or E
Key "check"	⇒	Change digit

Mode number can be switched with the keys "positive temp." or "negative temp.".

Back

6.4 Troubleshooting and error list

6.4.1 General information

All errors detected by the system are stored in an error list together with a number describing the cause and the error frequency.
This results in the troubleshooting procedure described in the following.

6.4.1 Troubleshooting procedure, types of error

The troubleshooting procedure results from the type of error:

- INOP immediately after switch-on
- INOP in self-test
- INOP during operation
- Sensor warning
- Keypad error
- Others

6.4.1.1 INOP immediately after switch-on

Description: Unit switches to INOP immediately after switch-on

Cause:
- Operating voltage faulty
- Controller PCB defective

Troubleshooting:
- Test voltage supply (see 4.4.3.1)
- Read out service LEDs on controller PCB (see 6.3.3)
- Attempt to read out error list (probably not possible)

6.4.1.2 INOP in self-test

Description: Unit switches to INOP after switch-on in self-test

Cause: Stored in error list or indicated by service LEDs on controller PCB

Troubleshooting:
- Test voltage supply (see 4.4.3.1)

- Read out service LEDs on controller PCB (see 6.4.2)
- Read out and assess error list

6.4.1.3 INOP during operation

Description: Unit switches to INOP during operation

Cause: Stored in error list

Troubleshooting: Read out and assess error list

6.4.1.4 Sensor warning

Description: Unit switches to INOP during operation

Cause: Stored in error list

Troubleshooting: Read out and assess error list

6.4.1.5 Keypad error

Description: Pressed keys are not recognised

Cause: Keypad or keypad evaluation on display PCB defective

Troubleshooting: Test keypad and keypad evaluation:

- Via service LEDs on controller PCB (see 6.4.2)
- Test keypad (see 4.7.3.2)

6.4.1.6 Others

Description: Faults not covered by the above sections

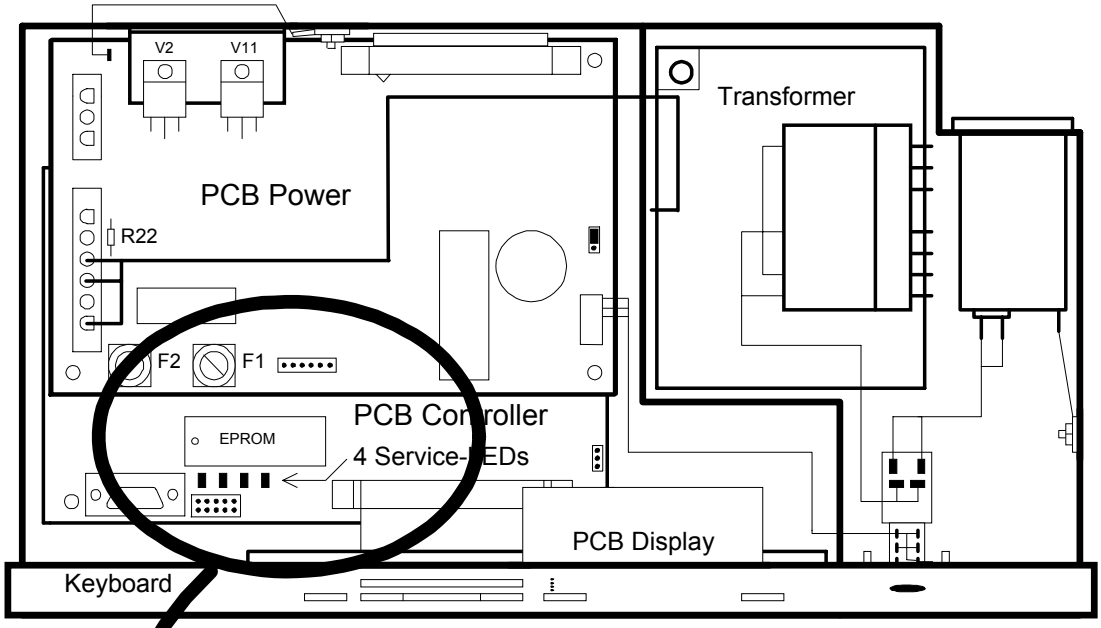
Cause: Non-monitored functions:

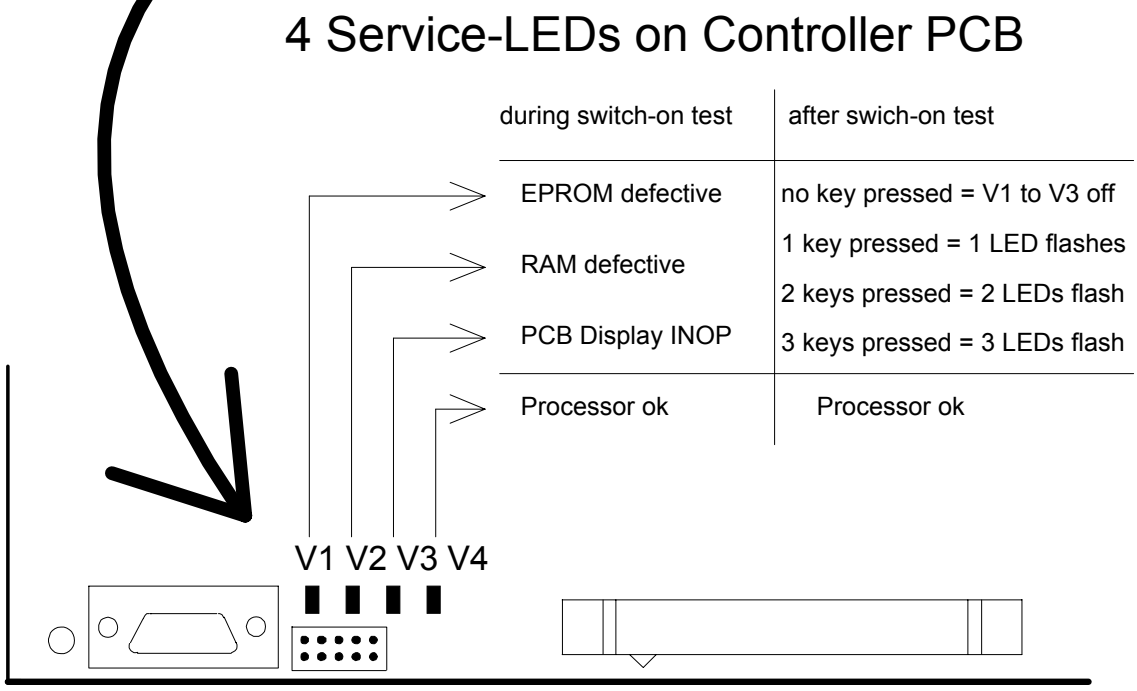
- Displays defective
  - o Modules for displays behind keypad and display driver on display PCB defective
- Permanent mains failure
  - o Power cord not correctly connected
  - o Mains input fuses defective (see 4.9)
  - o Fuse F2 for 5V supply on controller PCB

defective (see 4.4.2)

6.4.2 Service LEDs

Errors are displayed by the service LEDs on the Controller PCB in line with operating status:




4 Service-LEDs on Controller PCB
during switch-on test
after swich-on test
EPROM defective
RAM defective
PCB Display INOP
Processor ok
no key pressed = V1 to V3 off
1 key pressed = 1 LED flashes
2 keys pressed = 2 LEDs flash
3 keys pressed = 3 LEDs flash
Processor ok
V1 V2 V3 V4

In switch-on test:

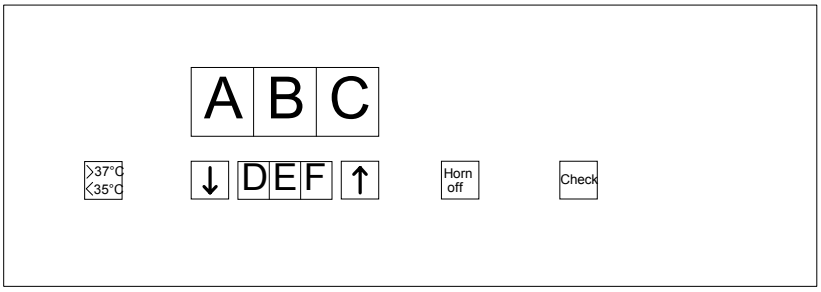
Error	Cause, remedy
LED V1 lights	Cause: - EPROM D2 on controller PCB defective - Controller PCB defective Remedy: 1) Renew EPROM (see 4.3) 2) If 1) unsuccessful: renew controller PCB (see 4.3)
LED V2 lights	Cause: RAM on controller PCB defective Remedy: Renew controller PCB (see 4.3)
LED V3 lights	Cause: - Display PCB defective - Actuation of display PCB on controller PCB defective Remedy: 1) Renew display PCB (see 4.5) 2) If 1) unsuccessful: renew controller PCB (see 4.3)
LED V4 off	Cause: - Voltage supply 5V defective - Processor on controller PCB defective Remedy: 1) Test voltage supply (see 4.4.3.1) 2) If 1) OK: renew controller PCB (see 4.3)

During the course of operation

Significance, error	Cause, remedy
LED V4 off	Cause: - Voltage supply 5V defective - Processor on controller PCB defective Remedy: 1) Test voltage supply, see 4.4.3.1 2) If 1) OK: renew controller PCB (see 4.3)
LED 1 - 3	Keypad test: One key pressed: ⇒ Only one LED flashes Two keys pressed: ⇒ Two LEDs flash Three or more keys pressed: ⇒ Three LEDs flash

6.4.3 Error list

All errors detected by the system are stored in an error list together with a number describing the cause and the error frequency.



A = F for error

BC = Error number (if present, otherwise "--")

DE = Error frequency (max. 15 displayed)

Error list can be read out in both directions with keys "positive temp." and "negative temp.".

Error list is deleted by pressing key "horn off" for more than 3 s.

Click on error number for viewing:

Acc	Err10	Err11	Err12	Err13
Err14	Err15	Err16	Err17	Err18
Err20	Err21	Err22	Err23	Err24
Err25	Err30	Err31	Err32	Err50
Err51	Err53	Err57	Err58	Err59
Err60	Err61	Err70	Err80	Err81
Err82	Err83	Err84	Err85	Err86
Err87	Err88	Err89	Err90	Err91
Err92	Err93			

Error number	Cause, remedy
Acc	**See also error 25** No failure if the unit was switched off for a longer time. Back / Err25
10	**EPROM D2 on controller PCB defective** Error recognition: Check sum EPROM incorrect during self-test Cause: - EPROM D2 on controller PCB defective - Controller PCB defective Remedy: 1) Renew EPROM D2 on controller PCB (see 4.3) 2) If 1) unsuccessful: renew controller PCB Back
11	**EPROM D2 on controller PCB defective** Error recognition: Check sum EPROM incorrect during operation Cause: - EPROM D2 on controller PCB defective - Controller PCB defective Remedy: 1) Renew EPROM D2 on controller PCB (see 4.3) 2) If 1) unsuccessful: renew controller PCB (see 4.3) Back
12	**RAM on controller PCB defective** Error recognition: RAM test in self-test unsuccessful Cause: - RAM on controller PCB defective - Controller PCB defective Remedy: Renew controller PCB (see 4.3) Back

Error number	Cause, remedy
13	**Software or RAM error** Error recognition: Incorrectly stored value in RAM Cause: - RAM on controller PCB defective - Controller PCB defective - External fault due for example to electrostatic charging Remedy: If error has occurred several times, renew controller PCB (see 4.3) Back
14	**Program run error on controller PCB** Error recognition: The program checks itself for correct program sequence Cause: - Interruption due to other error - EPROM error - Controller PCB defective Remedy: In the event of no other hard errors as well: 1) Renew EPROM (see 4.3) 2) If 1) unsuccessful: renew controller PCB Back
15	**EEPROM error on controller PCB** Error recognition: EEPROM test unsuccessful Cause: - EEPROM on controller PCB defective - Controller PCB defective - Wrong software version, see TSB Babytherm 8000 # 11 Remedy: Renew controller PCB (see 4.3) or software version. Back

Error number	Cause, remedy
16	**Watchdog on controller PCB defective** Error recognition: Watchdog time, heating monoflop outside tolerance Troubleshooting: See 6.2.9 Diagnosis mode 9 Remedy: Renew controller PCB (see 4.3) Back
17	**Watchdog on controller PCB defective** Error recognition: Watchdog time, INOP monoflop outside tolerance Troubleshooting: See 6.2.9 Diagnosis mode A Remedy: Renew controller PCB (see 4.3) Back
18	**Analog error** Error recognition: Short in several analog inputs at A/D converter Troubleshooting: Readout A/D channels in service mode; see 6.2.1 - 6.2.8. Remedy: Renew controller PCB (see 4.3) Back
20	**Temperature measurement on controller PCB defective** Error recognition: Input of temperature channel 1 (Vin0) is switched to test resistor 41.6 °C during test; resultant measured value is outside tolerance. Troubleshooting: See 6.2.1 Diagnosis mode 1 Cause: Controller PCB defective Remedy: Renew controller PCB (see 4.3) Back

21	**Temperature measurement on controller PCB defective** Error recognition: Input of temperature channel 3 (Vin2) is switched to test resistor 41.6 °C during test; resultant measured value is outside tolerance. Troubleshooting: See 6.2.3 Diagnosis mode 3 Cause: Controller PCB defective Remedy: Renew controller PCB (see 4.3) Back
22	**Excess temperature comparator on controller PCB defective** Error recognition: Input of temperature channel 1(Vin0) is switched to test resistor 41.6 °C during test, however excess temperature comparator has not switched. Troubleshooting: See 6.2.1 Diagnosis mode 1 Cause: Controller PCB defective Remedy: Renew controller PCB (see 4.3) Back
23	**Excess temperature comparator on controller PCB defective** Error recognition: Input of temperature channel 3 (Vin2) is switched to test resistor 41.6 °C during test, however excess temperature comparator has not switched. Troubleshooting: See 6.2.3 Diagnosis mode 3 Cause: Controller PCB defective Remedy: Renew controller PCB (see 4.3) Back

Error number	Cause, remedy
24	**Reference voltage on controller PCB defective** Error recognition: The reference voltage is read in on the controller PCB and is outside the tolerance. Troubleshooting: See 6.2.6 Diagnosis mode 6 Cause: Controller PCB defective Remedy: Renew controller PCB (see 4.3) Back
25	**Gold cap voltage defective** Error recognition: The voltage of the gold cap capacitor on the power PCB is read in by the controller PCB with charging voltage off. Troubleshooting: See 6.2.7 Diagnosis mode 7 Cause: - Gold cap on power PCB defective - Charging circuit on power PCB defective - A/D channel Vin 6 on controller PCB defective - Activation/deactivation of charging voltage on controller PCB defective Remedy: If all other A/D channels functioning: 1) Renew power PCB (see 4.4) 2) If 1) unsuccessful: renew controller PCB (see 4.3) Back

Error number	Cause, remedy
30	**Safety relay K1 on Power PCB defective** Error recognition: Relay K1 on Power PCB permanently closed Troubleshooting: - In diagnosis mode, see 6.2.A and 6.2.b: Switch on relay and heating in mode A and b: ⇒ Check-back signal = heating on Switch off relay in mode A and read out heating check-back signal in mode b: ⇒ Check-back signal = heating on = relay defective ⇒ Check-back signal = heating off = relay OK - Without diagnosis mode: See 4.4.3.2 Cause: - Relay K1 on Power PCB defective - Check-back signal from Power PCB defective - Read-in of check-back signal on Controller PCB defective Remedy: 1) Renew Power PCB or Relay K1 on Power PCB (see 4.4) 2) If 1) unsuccessful: renew Controller PCB (see 4.3) Back

Error number	Cause, remedy
31	**Heating cannot be switched off** Error recognition: Heating cannot be switched off by way of triac or relay on power PCB. Cause: - Relay K1 on power PCB defective - Relay V2 on power PCB defective - Actuation of relay or triac on power PCB defective - Heating status feedback on power PCB defective - Actuation or read-in of check-back signal on controller PCB defective Troubleshooting: - In diagnosis mode, see 6.2.A and 6.2.b: Switch on relay and heating in modes A and b: ⇒ Check-back signal = heating on Switch off relay or triac in each case in modes A and b and read out heating check-back signal in mode b: ⇒ Check-back signal = heating on = Relay defective ⇒ Check-back signal = heating off = Relay OK Without diagnosis mode: See 4.4.3.2 Remedy: 1) Renew power PCB (see 4.4) 2) If 1) unsuccessful: renew controller PCB (see 4.3) Back

Error number	Cause, remedy
32	**Heating cannot be switched on** Error recognition: Heating present but cannot be switched on. Cause: - Fuse F2 on power PCB defective - Relay K1 on power PCB defective - Triac V2 on power PCB defective - Actuation of relay or triac on power PCB defective - Heating status feedback on power PCB defective - Actuation or read-in of check-back signal on controller PCB defective Troubleshooting: - Check Fuse F2 on power PCB - In diagnosis mode, see 6.2.A and 6.2.b: Switch on relay and heating in modes A and b: ⇒ Check-back signal = heating on - Without diagnosis mode: See 4.4.3.2 Remedy: 1) Renew power PCB (see 4.4) 2) If 1) unsuccessful: renew controller PCB (see 4.3) Back
50	**Keypad and display driver on display PCB defective** Error recognition: The required display information from the RAM of the display and keypad driver D1 is read back on the display PCB during operation. Cause: - Display PCB defective - Controller PCB defective Remedy: 1) Renew display PCB or D1 on display PCB (see 4.5) 2) If 1) unsuccessful: renew controller PCB (see 4.3) Back

Error number	Cause, remedy
51	**Wrong key** Error recognition: Recognition of key which is not present. Cause: - External fault - Display PCB defective Back
53	**Service jumper on controller PCB forgotten** Error recognition: Service jumper on controller PCB in position X12/1-2 recognised as being connected for more than 30 s. Remedy: 1) Move jumper to park position 2-3. 2) If 1) unsuccessful: renew controller PCB (see 4.3) Back
57	**"Check" key sticking** Error recognition: Key recognised as having been pressed for more than 30 s. Cause: - Key on keypad defective - Display PCB defective Remedy: 1) If other keys function: renew keypad (see 4.8) 2) If 1) unsuccessful: renew display PCB (see 4.5) Back

Error number	Cause, remedy
58	**"Horn off" key sticking** Error recognition: Key recognised as having been pressed for more than 30 s. Cause: - Key on keypad defective - Display PCB defective Remedy: 1) If other keys function: renew keypad (see 4.8) 2) If 1) unsuccessful: renew display PCB (see 4.5) Back
59	**"Positive temp." key sticking** Error recognition: Key recognised as pressed for more than 30 s. Cause: - Key on keypad defective - Display PCB defective Remedy: 1) If other keys function: renew keypad (see 4.8) 2) If 1) unsuccessful: renew display PCB (see 4.5) Back
60	**"Negative temp." key sticking** Error recognition: Key recognised as pressed for more than 30 s. Cause: - Key on keypad defective - Display PCB defective Remedy: 1) If other keys function: renew keypad (see 4.8) 2) If 1) unsuccessful: renew display PCB (see 4.5) Back

Error number	Cause, remedy
61	**">37 °C/<35°C" key sticking** Error recognition: Key recognised as pressed for more than 30 s. Cause: - Key on keypad defective - Display PCB defective Remedy: 1) If other keys function: renew keypad (see 4.8) 2) If 1) unsuccessful: renew display PCB (see 4.5) Back
70	**Heating not connected or defective** Error recognition: Heating check-back signal negative. Cause: - Heating not connected - Heating high impedance - Power PCB defective Troubleshooting: - Heating connected? - Measure heating resistance approx. R = 4.8 ohms Remedy: If heating OK, renew power PCB (see 4.4) Back

Error number	Cause, remedy
80	**Temperature sensor defective (high impedance)** Error recognition: Temperature measured value too low. Cause: - Sensor 1, first half, high impedance on account of break in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 0) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back
81	**Temperature sensor defective (high impedance)** Error recognition: Temperature measured value too low. Cause: - Sensor 2, first half, high impedance on account of break in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 1) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back

Error number	Cause, remedy
82	**Temperature sensor defective (high impedance)** Error recognition: Temperature measured value too low. Cause: - Sensor 1, second half, high impedance on account of break in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 2) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back
83	**Temperature sensor defective (high impedance)** Error recognition: Temperature measured value too low. Cause: - Sensor 2, second half, high impedance on account of break in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 3) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back

Error number	Cause, remedy
84	**Temperature sensor defective (short circuit)** Error recognition: Temperature measured value too high. Cause: - Sensor 1, first half, high impedance on account of short circuit in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 0) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back
85	**Temperature sensor defective (short circuit)** Error recognition: Temperature measured value too high. Cause: - Sensor 2, first half, high impedance on account of short circuit in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 1) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back

Error number	Cause, remedy
86	**Temperature sensor defective (short circuit)** Error recognition: Temperature measured value too high. Cause: - Sensor 1, second half, high impedance on account of short circuit in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 2) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back
87	**Temperature sensor defective (short circuit)** Error recognition: Temperature measured value too high. Cause: - Sensor 2, second half, high impedance on account of short circuit in cable - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective (Vin 3) Troubleshooting: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back

Error number	Cause, remedy
88	**Short circuit in temperature sensors** Error recognition: Temperature measured values at measurement location (first half) too high. Cause: - Short circuit between sensors 1 and 2, first half - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective Remedy: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back
89	**Short circuit in temperature sensors** Error recognition: Temperature measured values at measurement location (first half) too high. Cause: - Short circuit between sensors 1 and 2, second half - Cable connection between controller PCB and connector on cover of electronics assembly defective - Temperature measurement on controller PCB defective Remedy: - Test sensors (see 3.2.1) - Test controller PCB (see 4.3) Back
90	**Excessive temperature difference** Error recognition: Temperature difference between sensor 1 (Vin 0) and 2 (Vin1) at joint measurement location (first half) more than 0.5 °C. Cause: - Measurement electronics on controller PCB defective - Sensors defective Troubleshooting: See 4.2 Remedy: Depending on cause Back

Error number	Cause, remedy
91	**Excessive temperature difference** Error recognition: Temperature difference between sensor 1 (Vin 0) and 2 (Vin1) at common measurement location (second half) more than 0.5 °C. Cause: - Measurement electronics on controller PCB defective - Sensors defective Troubleshooting: See 4.2 Remedy: Depending on cause Back
92	**Excessive temperature difference** Error recognition: Temperature difference between the two measurement locations on the heating panel (first and second half) more than 5.0 °C. Cause: If errors 90 and 91 not present: - Cold object on one half of heating panel - Heating defective (one half) Troubleshooting: - Measure heating resistance approx. R = 4.8 ohms - Cold object on heating Remedy: Depending on cause Back

Error number	Cause, remedy
93	**Excess temperature shutdown 41.6 °C tripped** Error recognition: Temperature of more than 41.6 °C, mandatory shutdown of heating Cause: - External heat source - Heating actuation defective Troubleshooting: See 4.2 Remedy: Depending on cause Back

6.5 10-minute test

A 10-minute test can be implemented in DS mode in the error list using the "check" key. During the test run (approx. 3 seconds) the "F" appears with a decimal point. In the event of errors being detected the unit does not switch to INOP, but rather merely stores the errors in the error list. Readout errors with key " ⇑ " and " ⇓ ".

7. Radiant heater 600W

The radiant heater 600 W is not part of this documentation; the radiant heater has its own service documentation.

8. List of test equipment and tools

The following test equipment and tools is/are required for repair work:

8.1 Primarily for work on electrical components

- Babytherm 8000 test plug (35.0 °C + offset) 79 01 965
- Uni test board with cable set 79 00 620
- Multimeter 79 01 021
- Measurement leads, at least 6 x, e.g.:
  - o Measurement lead, red, 1m, 2 x 79 01 022
  - o Measurement lead, black, 1m, 2 x 79 01 023
  - o Measurement lead, red, 0.25m, 2 x 79 01 679
  - o Measurement lead, black, 0.25m, 2 x 79 01 680
- Test prods, at least 6 x, e.g.:
  - o Test prod, red, Kleps 30, 4 x 79 01 026
  - o Test prod, black, Kleps 30, 4 x 79 01 027
- Test prods, at least 2 x, e.g.:
  - o Test prod, red, PP 130 79 01 024
  - o Test prod, black, PP 130 79 01 025
- Electrical Safety Tester

8.2 Primarily for work on mechanical components

- Hammer 13 22 850
- Hammer (plastic) 79 01 529
- Pin punch, 4mm 13 23 334

- Touch-up stick, blue, munsell 79 01 261
- Touch-up stick, bright orange, munsell 79 01 262
- Touch-up stick, grey-white, RAL 9002 79 00 380
- Set of 1 - 5 mm bits 16 37 428
- Drill (230 V) 79 01 604
- Epoxy hardening glue “UHU Plus“ 11 95 255
- Grease “Molykote 55 M“ 15 54 093
- Screw locking agent low-strength Loctite 221 79 01 966

8.3 Equipment for functional tests

- Temperature and moisture meter, complete 79 01 148

  From this set merely:

  - o Temperature and moisture meter 79 01 134
  - o Immersion-type sensor 79 01 335

9. File for repair information and unit modification

9.1 New software version 1.02 (07.94)

The software 1.02 will be used as soon as the series production is started. The software versions 1.00 and 1.01 used in the test devices are no longer valid.

- Software 1.00/1.01 Babytherm mattress heating not valid
- Software 1.02 Babytherm mattress heating 82 90 673

See also Chapter 5.1.

9.2 Mounting the mechanics of the resting-surface tilt-mechanism (09.94)

With immediate effect, the mechanics of the resting-surface tilt-mechanism must be mounted with 4 Spax screws (order no. 12 75 593). Devices already in service must be retrofitted with this type of screws, see IDM no. 1 and conversion instructions under "U", Chapter 2.1. The two cylinder head screws of the latch 2M 20 855 and the screw on the control lever must be secured with epoxy hardening glue (UHU-Plus, order no. 11 95 255). See also Chapter 1.5.6.1.

9.3 Alteration of class type B to BF (12.94)

9.3.0 Contents

9.3.1 Future IEC Standard

9.3.2 Differentiation of units

9.3.3 Changes in TC or to testing following repair

9.3.4 Changes to components and assemblies

9.4.5 Conversion from type B to BF

9.3.6 Repairs and S-parts

9.3.1 Future IEC Standard

The future Standard for mattress heating IEC 601-2-35 (as at 12.94) prescribes that the resting surface is no longer to be earthed and that class type BF (Body Floating) must be used. The units are currently being supplied as type B (Body) i.e. with earthed resting surface. Production of the Babytherm 8000 with mattress heating is to be switched as of the start of 1995 to class type Typ BF; prior to this date roughly 300 units will be delivered with the old class type B.

Subsequent alteration from type B to BF is not envisaged.

9.3.2 Differentiation of units

The difference can be seen from the stamp next to the rating plate of the Babytherm:

Type B: Type BF:

(Figure with no box)

(Figure in box)

To distinguish between type B and BF the mattress heating control and heating panel have different plugs for the heating connection:

Type B (old) - 3-pin connector for heating cable, one cable for protective conductor

Type BF (new) - 2-pin connector for heating cable

As not all parts of the mattress heating are interchangeable, the modified components have new order numbers. Always pay attention to repair information when performing repairs.

9.3.3 Changes in TC or to testing following repair

When performing protective conductor test, a check must be made on the basis of the Babytherm rating plate as to whether the mattress heating class is type B or BF:

- Type B:
  There must still be a protective conductor connection to the aluminium panel of the resting surface; there is no change to the test value of R ≤ 0.2 ohms.

- Type BF:
  There must not be a protective conductor connection to the aluminium panel of the resting surface; the test value is R = ∞.

Important: Differentiation is also possible by way of a mark on the control unit for the mattress heating. Newer control units for type BF feature a stamped mark on the underside, i.e. readily legible even when installed.

9.3.4 Changes to components and assemblies

9.3.4.1 Heating panel

The heating panels for types B and BF have different order numbers.

The following heating-panel parts differ:

Heating panel 2M 20 877 for type B	Heating panel 2M 21 510 for type BF
Double temp. sensor 2M 20 859 with shield connected to sensors. Identification: No yellow and blue shrink-down tubing at sensors. Sensor cannot be converted to type BF.	Double temp. sensor 2M 20 859 with insulated shield on sensor end, distinguished by sensors with blue and yellow shrink-down tubing. This sensor can also be used in type B. Alteration has already been made on some units of type B.
Foil heating 2M 20 876 with 3-pin connector: - 2 x heating - Protective conductor	Foil heating 2M 21 509 with 2-pin connector: - 2 x heating

Important: In future only the new heating panel 2M 21 510 will be available. The new heating panel 2M 21 510 for type BF will then have to be converted to type B in the event of repair. This will involve taking over the protective-conductor cable connection and 3-pin heating connector from the defective heating panel 2M 20 877. In this case the protective conductor connection is to be laid separately from the heating cables. To remove the connector, use can be made of the tool "Extractor for crimp socket 2.6 mm" with the order no. 79 01 120; another possibility is to make use of ballpoint-pen refills (with metal tube) with a tube ID of approx. 2.6 mm.

9.3.4.2 Mattress heating control

The mattress heating controls 220/240V for types B and BF have different order numbers.

Type B	Type BF
Mattress heating control 2M 20 880 Distinguishing feature: - 3-pin heating connection	Mattress heating control 2M 21 500 Distinguishing features: - 2-pin heating connection - Order no. printed on - Marked "BF"
RAT mattress heating control 2M 21 095	RAT mattress heating control 2M 21 506

Important: The control system 2M 20 880 and the RAT (repair/replacement) control system 2M 21 095 for type B will no longer be available in future.

Type BF controls are to be ordered as spare part for the old type B. On installation, merely the housing cover with the two wiring harnesses (heating adapter and sensor adapter) is to be taken over from the defective control system. The marking on the housing of the new control system is to be changed to type B and the order no. from 2M 21 500 to 2M 20 880.

Wiring diagram/wiring harnesses

There is no change to the cable connections between the PCBs. The only alteration is to the wiring harnesses (sensor adapter and heating adapter), i.e. the two cable connections from the cover to the PCBs.

Type B	Type BF
Wiring harness Heating adapter 2M 21 096 3-pin adapter cable without ferrite between heating connection on housing cover and power PCB.	Wiring harness Heating adapter 2M 21 507 2-pin adapter cable with ferrite between heating connection on housing cover (2-pin) and power PCB (3-pin).
Wiring harness Sensor adapter 2M 21 094 Wiring harness with ferrite 18 31 577 between sensor connection on housing cover and controller PCB. This cable can also be used in type BF.	Wiring harness Sensor adapter 2M 21 508 Wiring harness without ferrite between sensor connection on housing cover and controller PCB

Controller PCB

Use in the type BF requires additional capacitors in the measurement input which cannot be retrofitted in the field. Retrofitting has already been performed if the modification number after the order no. is ³ 1.1, i.e. the PCB is marked with 82 90 668 - 1.1 or a higher modification number. Some units of type B already feature this modification.

Controller PCB 82 90 668 ≤ 1.0	**Controller PCB 82 90 668 ≥ 1.1**
Only for use in type B. Use in type BF could result in destruction of measurement input caused by the influence of voltage peaks	Can be used in types B and BF

9.3.4.3 Power cord for mattress heating control

This refers to the short internal mains lead 2M 21 220 between the triple socket in the Babytherm and the mattress heating control.

Type B	**Type BF**
Ferrite 18 34 967 required on cable	No longer ferrite on cable. If already fitted, ferrite need not be removed

9.3.4.4 Operating instructions

There are different operating instructions for types B and BF.

Type B	**Type BF**
Joint operating instructions for Babytherm 8000 WB (Heated Cot/Resuscitation Unit) and Babytherm 8000 OC (Resuscitation Unit/Open Care Unit): - German 90 28 228 - English 90 28 253	Babytherm 8000 WB (Heated cot/Resuscitation Unit)): - German 90 28 323 - English 90 28 324 - French 90 28 325 - Spanish 90 28 326 - USA 90 28 327 Babytherm 8000 OC (Resuscitation/Open Care Unit): - German 90 28 352 - English 90 28 353 - French 90 28 354 - Spanish 90 28 289

9.3.5 Conversion of type B to BF

Subsequent alteration of type B to BF is not envisaged.

9.3.6 Repairs and S-parts

The modified S-parts are listed below:

Mattress heating control:

Type B	**Type BF**
Mattress heating control 2M 20 880 Distinguishing feature: - 3-pin heating connection	Mattress heating control 2M 21 500 Distinguishing features: - 2-pin heating connection - Order no. 2M 21 500 - Marked "BF"
RAT mattress heating control 2M 21 095	RAT mattress heating control 2M 21 506
Wiring harness Heating adapter 2M 21 096 3-pin adapter cable without ferrite between heating connection on housing cover and power PCB.	Wiring harness Heating adapter 2M 21 507 2-pin adapter cable with ferrite between heating connection on housing cover (2-pin) and power PCB (3-pin).
Wiring harness Sensor adapter 2M 21 094 Wiring harness with ferrite 18 31 577 between sensor connection on housing cover and controller PCB. This cable can also be used in type BF.	Wiring harness Sensor adapter 2M 21 508 Wiring harness without ferrite between sensor connection on housing cover and controller PCB
Controller PCB 82 90 688 ≤ 1.0 Only for use in type B. Use in type BF could lead to destruction of sensor input caused by the influence of voltage peaks	Controller PCB 82 90 688 ≥ 1.1 Can be used in types B and BF

Heating panel:

Type B	Type BF
Heating panel 2M 20 877 Distinguishing feature: - 3-pin connecting cable for heating with protective conductor	Heating panel 2M 21 510 Distinguishing feature: - 2-pin connecting cable for heating with no protective conductor
Double temp. sensor 2M 20 859 with shield connected to sensors. Identification: No yellow and blue shrink-down tubing at sensors. Sensor cannot be converted to type BF.	Double temp. sensor 2M 20 859 with insulated shield on sensor end, distinguished by sensors with blue and yellow shrink-down tubing. This sensor can also be used in type B. Some type B units already feature this modification.
Foil heating 2M 20 876 with 3-pin connector: - 2 x heating - Protective conductor	Foil heating 2M 21 509 with 2-pin connector: - 2 x heating

Important:
As regards the ordering of spares, only parts for type BF will be available in future. In the event of repair, these parts can be converted to type B; refer to Section 9.3.4 or to the appropriate component sections in "3. Heating panel with sensors" and "4. Mattress heating electronics".

9.4 Additional height adjustment extra high (02.95)

On request, the Babytherm 8000 OC (Resuscitation/Open Care Unit), i.e. devices equipped with the large trolley 2M 21 036, can be supplied with an electrical height adjustment which is 64mm (= 2.5 inch) higher than the normal one. This extra high height adjustment must not be used on the Heated Cot Babytherm 8000 WB with the short trolley. For further details, refer to Chapters 1.1.2 und 1.2.

9.5 Castors of non-height-adjustable units (03.95)

Units which are not equipped with an electric height-adjustment facility manufactured in 1995 (ARJx-xxxx) may occasionally be provided with castors secured by an additional stud screw M6 for reason of tolerance, see chapter 1.1.1.1 “Removal and installation of castors“.